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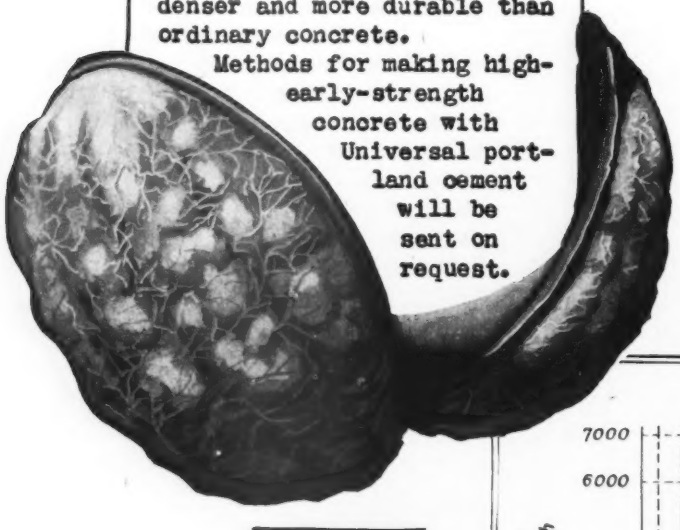

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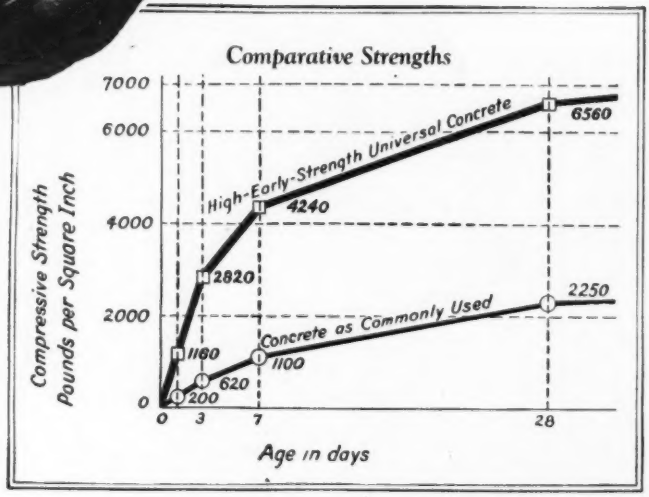

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Clearing Away Some Brush

MORE than a year ago *Engineering News-Record* asked a leading student of concrete, "Can the principles of concrete proportioning be put in simple terms, and the rapidly growing complication of the subject cleared away?" The query originated in the belief that the path of progress in concrete has become obstructed by a tangled growth of unnecessary theorizing, tending to place even the most careful traveler in danger of going astray. There are actual field cases of concrete structures which have proved defective despite an honest effort to carry out some of the current complex theories.

ACCORDINGLY F. R. McMillan, to whom the question was addressed, agreed to set down concrete's basic principles of manufacture in clear, simple and practical form. The result of a year's work on this task is a series of articles beginning in the April 11 issue on

Basic Principles of Concrete-Making

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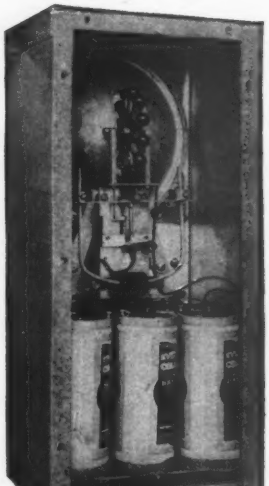

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A Builder

SAMUEL REA'S passing takes away one of the great constructive figures of the modern railroad era. Endowed with tact and wisdom and thorough technical instincts, he labored with success during more than a generation at the task of assuring the sound future development of the Pennsylvania Railroad. His studious, deeply penetrating mind and his firm decision were more largely responsible than any one other factor for the successful completion of the Pennsylvania Railroad's prodigious tunnel and terminal system at New York and its connection with the New England track network. His leadership inspired far-seeing studies of the physical elements of railway operation. More truly than any other he typified the spirit of that era of railway development which replaced the successive periods of the mileage-building pioneers and the later stock-market giants. The career that earned him this distinction brings honor to the engineering profession from whose ranks he came.

New Materials and Processes

IN VIEW of the cable trouble at the Mount Hope suspension bridge, reported this week, it is gratifying to note the promptness of the engineers and contractors to decide on complete replacement of the present cables despite the great cost and delay. Without such replacement doubts of the safety of the bridge would be likely to remain. The sensational wire breakages reported are a reminder of the fact that the adoption of new materials and processes sometimes brings unpleasant surprises. The service behavior of any material is a complex matter, and prediction of future behavior from the limited number of tests which can be applied in advance is something less than certain. The laboratory cannot reproduce all the conditions which a material may meet in service. Moreover, the proper methods of manipulation of the material often have to be evolved through long-time trial and experience. For example, the cable wire used in the two bridges mentioned displayed amazing toughness and deformability in laboratory tests—it could be coiled into a close helix without cracking; yet the breaks which developed in the field, occurring after a considerable time and under quiescent conditions, suggest brittleness or else a change in the material in the course of some months. At the points where the breaks occurred the wire had been subjected to an unusual manipulation by giving it a sharp bend in order to form it to the contour of the cable strand shoes, but to what extent this was a factor in the case is not yet known. Full explanation of the trouble which has developed will no doubt add important chapters to present-day knowledge of steel. At the moment, however, it is proper to remark that these wire breakages have no bearing on the safety of existing suspension bridges, or indeed on the safety of suspension bridges in general. From earliest days suspension bridges have been among the safest structures man is capable of building, and this renown has been amply confirmed by the experience of centuries. That new materials and processes have brought serious trouble to two bridges under construction in no way lessens this reputation.

Deep Pier Construction

ONE of the largest open-caisson foundations yet built is to be undertaken in the construction of the Suisun Bay bridge of the Southern Pacific. The difficult conditions of subsoil and the strong currents in which the foundations must be built make the construction specially unusual. Accordingly, the methods used in carrying out the work will invite careful study. The tendency of recent years to more extensive use of open methods of foundation work should receive further impetus from this undertaking, and its success will wipe out the discouraging influence of the misadventure which the open-caisson method encountered in the tipping of a caisson at the Poughkeepsie bridge—an accident made good only after more than a year's strenuous recovery work. Aside from the construction problems involved, the piers of the Suisun Bay bridge also claim notice because of the full consideration given in their design to earthquake hazards. It is no small problem to support a load of many thousands of tons at a height of more than 200 ft. above the pier bases and hold this tremendous mass securely in the violent shaking of an earthquake. But the depth of the footings is a favoring factor, in view of the observation that earthquake motions are much smaller some distance down than at the ground surface.

On With the Attack

ATTACK on sewage-treatment problems is being made vigorously in many quarters. The interest and zeal of those in the struggle were attested at Trenton last week, where scores of sewage-works operators and engineers of private practice attended four lengthy sessions of the New Jersey Sewage Works Association. Long a lone pioneer, this association has built up a reputation that attracts to its conventions men from distant points. Boston, Syracuse, Columbus and Kansas City were represented this year, as also Philadelphia and Baltimore. The meeting at Trenton showed no end of operating and research problems that need attention. Among the latter is the best method of determining biological oxygen demand and how to get comparable results, city with city. Recent discussions on this subject show anew what a complicated and variable substance has to be dealt with at sewage-treatment works. Long continued, earnest and intelligent as has been the research in this field, only a beginning has yet been made. Now that the larger cities of the country are following the smaller ones in sewage treatment and the pressure for a higher degree of treatment is increasing, research work in the laboratory and on a working scale at treatment plants is needed more

than ever. Such work will not only point the way toward more efficient treatment but will also show how it can be done at the least capital and operating cost. A sewage-works association in every state of the Union is needed to stimulate sewage research and, perhaps more important, to increase the efficiency of sewage-works operators.

Rigid Frames in Steel

EXTENSION of rigid-frame construction to steel, a pioneer case of which is described in this issue, constitutes an interesting development in the structural art. It involves questions somewhat different from those arising in the case of a similar concrete structure. In the latter the concrete abutment structure is easily integrated with the span, while in the case of the steel span, where continuity is obtained by carrying steel supporting frames through the abutment down to the foundation, the resulting proximity of the steelwork to the abutment fill calls for unusual precautions to embed the abutment members if long life and maintained strength are to result. If this problem can be handled effectively, the method offers an economy too large to ignore, especially as grade-crossing structures are critically affected by cost. But the application of rigid-frame construction to short spans should also encourage a study of its possibilities in large structures. Some large bridges of rigid-frame type have been built in Europe, while American practice, on the contrary, has carefully avoided it. Except for one or two viaducts of arch form, bridges have been characterized by a painstaking avoidance of continuity between span and tower support. But as recent years have seen the antipathy to constrained structures diminish steadily, there may now be better opportunity to consider long-span applications of the frame principle.

Modernizing Buildings

PHILADELPHIA last week was added to the list of cities which have advanced their building code stress allowance for structural steel from 16,000 to 18,000 lb. per sq.in. With this advance, and the same change embodied in the draft of the new codes of New York and Chicago, the modernization of old-fashioned practices in steel construction is progressing encouragingly. For 35 years or more the figure of 16,000 lb. per sq.in. has exerted a tyrannical sway over steel construction, dominating all practice and in time coming even to dominate and straitjacket structural thought. It is interesting to observe that bridge engineers, who in general are sufficiently conservative, have gone well beyond 16,000 and today may be said with some reason to be on a 20,000-lb. basis. Building practice, therefore, still lags behind bridge practice, although it is concerned with almost pure dead-load service in contrast to the severe live-load service of railway bridges. It is true that rigidity is an important though not a calculated consideration in the field of high buildings, and it is also true that bridge engineering is more careful in its calculations. Yet there are some high buildings which, though designed for higher stress than 16,000, prove themselves amply strong and rigid and therefore show that an unduly low stress is not necessary to safeguard against structural uncertainties. Low stresses in building practice have often been defended on the ground that it is necessary to provide a margin against incompetence and sharp practice on the part of structural designers, but this argument is unsound in its premise and vicious in its conclusion. No branch of engineering has ever been safeguarded by enforced inefficiency.

What Engineers Do

IN THE activated-sludge plant at Pasadena there is a drier whose function it is to reduce the moisture content of sludge cake from 80 to 5 per cent. Several years' operating experience proved that this was a good drier and that it was doing all that could be expected of it, despite various expedients for increasing its capacity. In 1927, $37,000 was spent for burying sludge that the drier could not handle. Then a good fertilizer market was developed for dried sludge. The obvious need seemed to be the installation of another drier; any business man could have shown the economy of such a move. To the engineer, however, this was not necessarily the solution. Instead of buying another drier the engineer in charge worked out a scheme for pretreating the sludge with diatomaceous earth in such a way that the capacity of the original drier was tripled and the entire sludge handled with the same fuel and labor costs previously required for drying a part of it. Although this requires some outlay for a pretreatment tank, on which capital charges should be allowed, and the purchase of diatomaceous earth and more power, these items combined go but a small way toward offsetting the saving effected by the change. It would be an excellent thing if the public would acquire the habit of associating the term "engineer" with the man trained to render this sort of service instead of with the man who operates a surveying instrument or a locomotive.

More Wisdom

TRANSFORMATION of modern industrial affairs in the direction of sounder economic management based on engineering insight has been going on so rapidly that many people, even engineers themselves, have not been fully aware of it. In particular the banker has been charged with overconservative views in this regard, and accordingly the continuance of policy dictation by bankers has often been decried, perhaps more often than is fair. The fact is that policies of both production and commerce, including the human item of personnel relations, necessarily are controlled ever more directly by the technically equipped specialists of industry. This was expressed in pertinent words recently by a banker, S. A. Lewisohn, in an address at Cornell University, which included the following remark: "The men today who have the greatest influence on labor relations policies are the local managers in charge of production, usually engineering executives. Directors are almost helpless in instituting an enlightened labor policy unless the managers in active charge understand and actively believe in it." Such a statement is most gratifying, but it also expresses a very definite obligation. If engineers are to succeed in shaping industrial policies soundly, they will need much wisdom and broad outlook—well beyond the range of mere technique. Not all are adequately equipped for this service today. Statements in the above-mentioned address indicate that many industries are hampered by too narrow vision and understanding on the part of engineering executives. If the industrial medievalism whose vestiges still survive in certain fields, such as the steel industry, is to be fully reformed, it will be achieved only by virtue of more wisdom on the part of engineering leaders.

A Well-Conceived Plan

CENTRIFUGAL and centripetal forces have made the city burst its bounds and at the same time drawn in outlying areas and caused them to grow at rates exceeding that of the central organism. These physical changes with their multifarious social and industrial connotations have not been met or even approached by governmental changes. The result is urban chaos. A well-wrought plan to meet this general situation is now before the Pennsylvania Legislature as a proposed charter for the consolidated city of Pittsburgh, coterminous with Allegheny County and largely but not wholly taking over the governmental functions of the county on the one hand, while on the other the intent is to preserve the autonomy not alone of Pittsburgh but of 122 other civil divisions. Before taking up this interesting proposal some consideration will be given to the multi-urban or regional problem as a whole.

The greatest obstacle to co-ordinating and satisfying the needs created by multi-urban growth centering around a city dominating in size and industry but powerless governmentally outside its chance arbitrary boundary limits has been lack of the larger governmental units essential to the purpose. On its face, the county seems a way out, but so much inefficiency, extravagance and bad politics are found in county government as to make it hopeless for the purpose. Reduction or complete elimination rather than enlargement of county functions would be welcomed by most friends of good government.

Consolidation of the dominant city of a county with all its lesser civil divisions naturally suggests itself. This was done years ago at Philadelphia, Denver and San Francisco. It resulted from the creation of Greater New York in 1898, but with the five boroughs coterminous with as many counties, some of which were created at the time. The borough plan for Greater New York followed ten years after the creation of the Administrative County of London, which includes the ancient cities of London and Westminster and 28 boroughs—virtually 30 cities in all except name.

In theory, the borough as a part of the County of London and of the present city of New York preserves local autonomy. The borough system was taken over as a part of the County of London, not created. Decades earlier some of the borough functions had been transferred to the London Metropolitan Board of Works—as somewhat later a metropolitan board of health was created for New York City, Brooklyn and adjacent territory. There is no close parallel between the general government of the County of London in relation to its boroughs and Greater New York and its boroughs. Moreover, in the case of the London metropolis, there is a water board having jurisdiction over a much larger area than has the county council while, larger still, and under the general government, is the police administrative area. Then there are two river conservancy boards and a port authority at London, besides an "Electricity Authority," of wide jurisdiction, and an asylums board. In Greater New York, as was pointed out in these columns a week ago, there is an arbitrary allotment of the same functions between the general city administration and the borough presidents, with unsatisfactory results.

The drafters of the charter for the proposed consolidated city of Pittsburgh, outlined elsewhere in this issue, offer a more comprehensive, logical and workable plan of government than those of the New York or the London metropolis—as might be expected in a document drawn to meet the urban conditions of today. The 123 cities, boroughs and townships in Allegheny County are left undisturbed; but all works and services which are or may become countywide in scope are transferred, actually or prospectively, to the control of the consolidated city of Pittsburgh. Moreover, provision is made for the taking over by the consolidated city of some works less than countywide in extent, but not confined to a single municipal division, on agreement with the local authorities. Independent of all this, provision is made for the consolidation of municipal divisions (cities, boroughs and townships) within the consolidated city. The threefold possibilities just outlined provide a way for a gradual unification of the works, services and municipal divisions of the entire area, but leave to local option everything except the countywide works and services, such as through-traffic streets, bridges and tunnels, regional transit and water supply. The district service for two or more municipal divisions, by inference, would include intercepting or outfall sewers and sewage disposal.

Unification of services that are or might well be county wide is not left to chance. Major space in the charter draft is given to the preparation of a master plan. This, wisely, may be drawn and adopted by sections. The fact that the need for intelligent planning does not stop at the city or county line is dealt with by giving the planning commission jurisdiction in some respects five miles beyond the city-county line.

The sections laying out the framework of government are skillfully drawn. If these show more of the old-type mixed powers than some would approve, it may be assumed that this was with an eye and ear to local sentiment. The mixed powers lie chiefly in two facts: First, the commendably small commission of seven members includes a president who is at the same time a member of the legislative and appropriating body and, by designation, chief administrative officer of the consolidated city. Second, this chief administrative officer, although appointing and having power of removing all department heads, is in reality under the control of a majority of the commission in both respects.

The twelve administrative departments of the city are well conceived. Most of them are single headed; where not, there is at least strong argument to the contrary, and reasonable provision for competent executive direction is made.

At a time when consideration is being given to metropolitan and regional problems embracing a single county or several counties, the charter for the proposed consolidated city of Pittsburgh will be welcomed and studied in many parts of the country, particularly in adjacent Ohio, where a constitutional amendment authorizing metropolitan county government in eight counties of the state is now before the legislature. The problem is less simple, governmentally considered, where provision has to be made for a region extending beyond the limits of one county. In some such cases the consolidation of two counties, as has been proposed quite recently for San Francisco and San Mateo counties, California, may be the solution; or again, the combination of parts of two or more counties into one. Political opposition to any plan may be counted on, since the continuation of "as is" makes for ease of political control; but multi-urban and regional problems, engineering and governmental, are increasing daily in number and urgency. They must be met, no matter whose and how many political corns are trod upon.

Arc-Welding Practice on a Large Hotel Building

Placing Column Splice Plates and Seat Angles a Constant Distance From Column Webs Effects Economies—No Overhead Welding

By H. M. Priest
American Bridge Company, New York City

A DISTINCT advance in the application of welding to the construction of a skyscraper-type building has recently been made with the completion of an addition to the Homestead Hotel at Hot Springs, Va. The desire of the owners to minimize the noises of construction precluded the use of field riveting and led to the adoption of electric-arc welding. This method of construction proved an excellent choice, and the entire erection was carried out with practically no disturbance of the hotel guests. In addition several new and important practices in welded construction were developed on the job, chief among which were the following: the exclusive use of constant dimension rolled column shapes, a reduction in the amount of shop handling of heavy columns and girders by placing all field bolt holes in details, and the development of an insert plate column splice and of a beam-to-column connection, both located a constant distance from the center line of the column. The column splice detail provided for the efficient splicing of columns of different sizes, while the location of all seat angles a constant distance from the column center line made possible an extensive use of duplicate length beams.

The general character of the building is shown in Fig. 1. A central tower portion, approximately 60x72 ft., rises to a height of 180 ft. and has eleven full floors, with smaller floors within the sloping roof and the cupola. The tower is flanked on either side by six-story wings, about 40x47 ft., which connect to the main body of the hotel and to the east wing. The columns are set back on all four sides of the tower at the eighth and ninth floors. The floor construction is of the long-span type of reinforced concrete with two-way reinforcing and was designed for a total floor load of 150 lb. per square foot. The steel beams were considered to be simply supported at their ends.

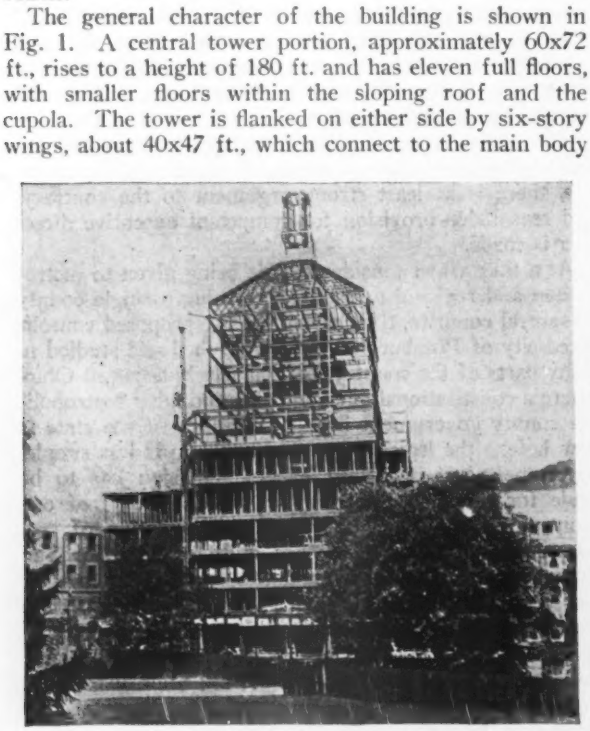


FIG. 1—WELDED FRAME OF HOMESTEAD HOTEL, HOT SPRINGS, VA.
The building includes a tower 180 ft. high and two side wings six stories in height.

FIG. 2—WELDED SPECIMENS USED IN TESTING CONNECTION DETAILS
At left, column stub is under testing machine head in position to apply load to welded angle connections on flanges. At right, a welded seat angle is shown after failure. Note punched plates welded between flanges for column splice.

Calculations for wind moments and shears were made for the tower portion of the building only, and the end connections of beams connecting to columns were so designed as to permit welding for the required moment. No calculations were made for the wings, but a nominal amount of welding was provided for stiffness of the structure. The unit stresses used in the design were based on 18,000 lb. per sq.in. in tension.

It would have been possible to use rivets in the shop fabrication, but in order to try out as far as possible an all-welded structure the American Bridge Company decided to use welding in both shop and field. Standard electric arc direct-current welding machines of the leading manufacturers were used for the work. Bolts were used in the field to hold the structure in line during erection, and field welding was applied where the bolts were not sufficient for use in the permanent structure.

A unit stress of 3,000 lb. per linear inch of $\frac{1}{8}$-in. fillet weld was adopted. This value was based on an extensive series of tests for the American Bridge Company carried out at the U. S. Bureau of Standards in Washington, D. C. Fig. 2 shows a specimen set up for testing, illustrating the method which was followed, and also shows a 6x4x$\frac{1}{8}$-in. seat angle after it had been tested to failure under a load of 216,500 lb. The average ultimate stress on the welds for all of the types tested gives a factor of safety of more than 4 based on the working stresses adopted.

The design of the steel structure followed usual practice with the exception that the ends of beams and

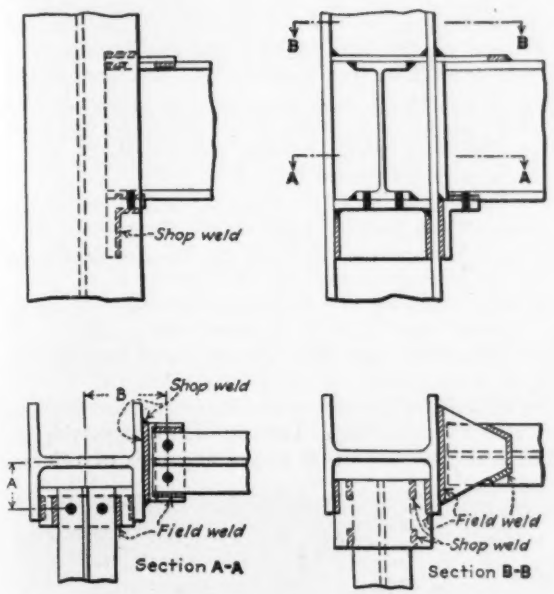


FIG. 3—TYPICAL BEAM-TO-COLUMN CONNECTION
Note method of welding seat angle out from column web to keep beams of constant length. Dimensions *A* and *B* are also maintained constant to make possible further duplication of details of the beams.

girders were supported in bearing rather than by web connections. This method avoided the necessity of finishing the beams to exact length and saved much field welding.

The principal items in a tier building are columns and beams, and it is especially desirable to keep pieces alike so far as that is possible. Also, handling is one of the principal items of expense, and in the development of the details of this building the aim was to confine all punching to the connections, thereby reducing the amount of handling of heavy pieces such as column shafts and girders.

General use of constant dimension columns, having a constant distance out to out of flanges, made it possible to keep beams framing between column flanges of a constant length for several floors. The same duplication was made possible for beams coming into the column webs by welding a seat angle between flanges and locating it out from the web instead of welding it against the web. In Fig. 3 the details of typical connections of beams to columns are illustrated. The holes punched in the seat angles and the bottom flanges of the beams constituted all the punching necessary for the erection of beams. In addition to keeping the ordered lengths of beams alike, a further duplication of details of the beams was secured by maintaining the distances *A* and *B* in Fig. 3 constant. Thus the location of the seat angles which were welded between the column flanges was primarily governed by the lengths of the beams resting upon them. These beams were cut back so that they could be tilted and dropped past the insert column splice plates without tilting the columns. One great advantage of this location of the seat angles was the avoidance of variations in the details due to varying column web thicknesses and to the fillets.

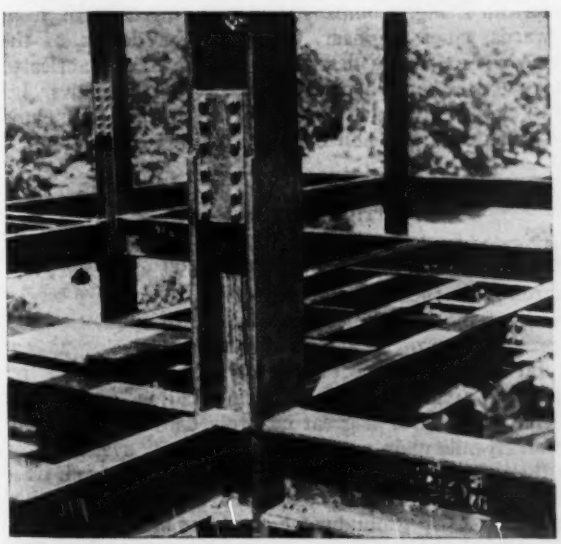


FIG. 4—DETAIL SHOWING COLUMN SPLICE
Splice consists of punched plates shop-welded between the column flanges a constant distance out from center line of the columns, to which is bolted the field splice plate. Note beam-to-column connection which is also shown in Fig. 5.

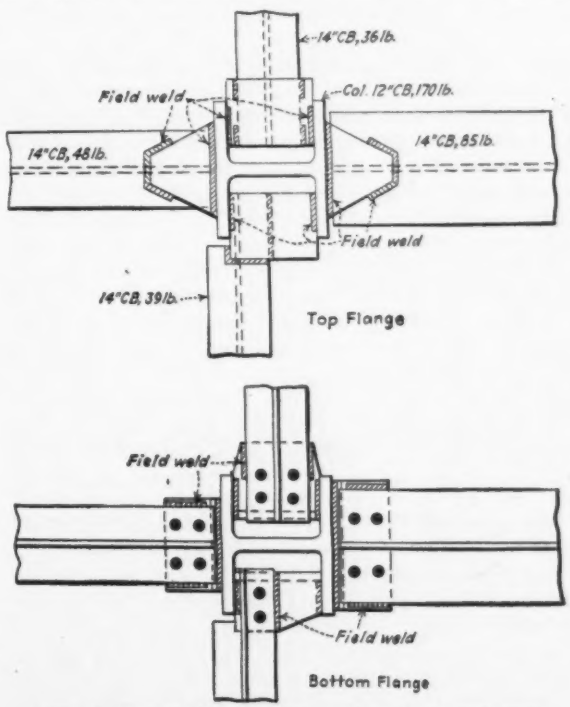


FIG. 5—SPECIAL BEAM-TO-COLUMN CONNECTION

The column splice shown in Fig. 4 was an unusual feature and was composed of plates, punched for the bolts, inserted between the column flanges and shop-welded. The faces of these plates were at fixed distances from the center line for each size of column. The splice plates were bolted in the field over the upper and lower insert plates. The column splice, consisting of plates welded between the flanges so detailed that they can be maintained at a constant distance from the center line regardless of the size and weight of the columns, and the seat angle between flanges, which embodies the same feature, are covered by patent applications. These two details eliminated all punching and drilling of the column shafts.

The wind moments at the ends of beams were transmitted by field-welding the bottom flanges to the outstanding leg of the seat angles and welding a plate to the top flanges and to the columns. For beams on the

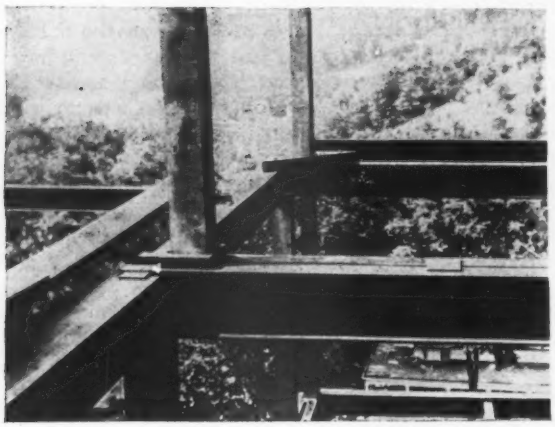


FIG. 6—OFFSET COLUMNS AT EIGHTH FLOOR

flanges of the columns a loose plate was laid on top and welded as shown in Figs. 3 and 4. In the case of beams on the web the top plate was shop-welded to the beam and field-welded to the column flanges. Fig. 5 is a plan of the top and bottom flanges of the beams framing to the column in the center of Fig. 4.

The method of carrying the offset columns at the eighth floor is illustrated in Fig. 6. The column rests on a slab on a double beam girder supported on the top of the column below. The spandrel beams were made of such a depth that they could be entered between the flanges of the girder beams and bear on the upper side of the bottom flanges as shown in Fig. 7. The two 16-in. beams forming the girder were spaced at the end with a 10-in. channel, which also served to take field welding to the plate which had been shop-welded to the edges of the flanges of the lower columns. It will be noted that all the loads at these points were transmitted in bearing rather than through shear connections, which would have required a large amount of field-welding.

The field erection was handled by a 12-ton stiff-leg derrick mounted on a braced tower placed just outside the building line. The tower was not moved during the entire erection of the building. The procedure was to erect a tier of columns and beams, bolting all the field connections. The columns were then plumbed with cables and the cables kept on until the tier had been welded. The erection of the next tier was carried on simultaneously with the welding of the lower tier. Two welders were able to keep pace with the raising gang. Current for the welding was derived from two sources —a motor generator set operating from the hotel's own

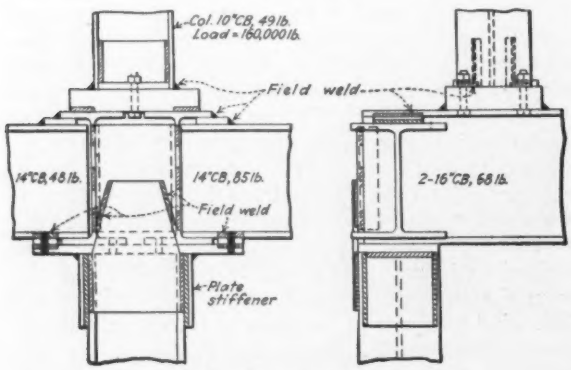


FIG. 7—DETAILS OF OFFSET COLUMN AT EIGHTH FLOOR

power supply, and a gasoline engine-driven generator set.

Because of the care taken in the details to have all welding accessible from above and all overhead welding eliminated, it was unnecessary to provide any staging for the welders, who could thus sit on the beams and reach all the points at which welding was required. Fig. 8 shows a welder at work.

On the sloping roof T's were welded to the rafters to support the precast roof slabs. Instead of fully detailing and punching the T's at the hips for fabrication in the shop, the material was shipped from the mill a few inches too long and the bevel cuts made by flame-cutting after the T's were in place. This method simplified the work in the drawing room and proved satisfactory in the field.

No difficulty was encountered in setting the 560 tons of steel for this building. The manner of supporting the beams and girders on seat angles and tops of columns

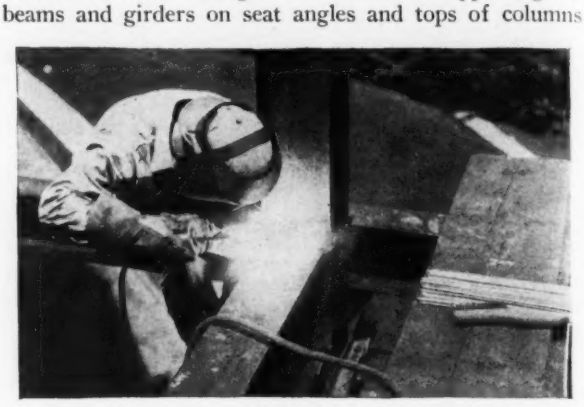


FIG. 8—WELDING A BEAM-TO-COLUMN CONNECTION ON HOMESTEAD HOTEL
No staging required for the welders, since the details provided for all welding from above.

made for ease of erection and saved considerable temporary field-bolting. When welding had been finished, the result was a well-stiffened building.

Warren & Wetmore, of New York, were the architects for the building and H. G. Balcom, of the same city, was consulting engineer on the steel design. The American Bridge Company, under the direction of J. H. Edwards, chief engineer, developed the design of the frame, arranged the details for welding and fabricated and erected the structural steel. W. J. Mathews, Jr., chief engineer of the Virginia Hot Springs Company, had general supervision over the entire construction.

Irrigation in India

Irrigated lands in India in 1927 had an area of 28,243,879 acres, as compared with 27,156,399 acres in 1924, according to the triennial report of the public works branch of the government department of industries and labor. These projects are distributed in twelve provinces. By far the most important construction is that on the Cauvery Metur project, in the Madras presidency, which provides for a great concrete dam and reservoir and an 88-mile main canal with distributary system serving the delta of the Cauvery River. Seepage from irrigation canals is causing extensive trouble, as in this country, rise of groundwater level resulting in waterlogging of the soil and the spread of salts which render the soil useless for cultivation. Experiments are being made with remedial measures and the government has appointed an engineering committee to study the problem.

Precast Floors of Novel Design Used in Two Buildings

Two Standard Sizes of Precast Units Placed With Reinforcing and Joined Into Solid Slabs by a Job-Poured Keyway

By Max Miller
Chief Engineer
Pre-cast Floors Corporation, New York City

THE precasting of long-span floors has always been balked by the problems of producing, transporting and handling at a building site units running from 15 to 25 ft. in length, and units of many special lengths. Recently the writer devised a precast floor construction in which standard size mass production material is used to fit any column spacing or irregularity of bays. Two jobs have been satisfactorily installed and the type of construction has successfully passed tests by Columbia University and has been approved by the New York City building department.

Description of System—As shown in Fig. 1, each precast beam is made up of three separate cast pieces laid lengthwise on hanging scaffolding. The reinforcement

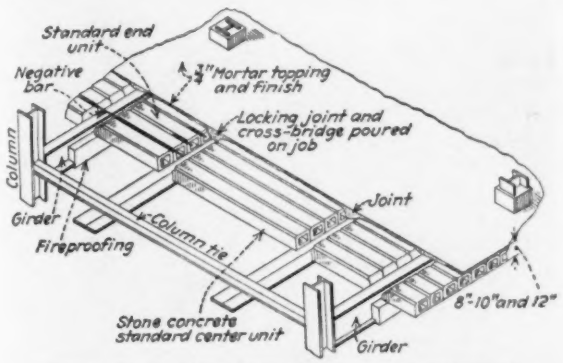


FIG. 1—ARRANGEMENT OF PRECAST UNITS IN FLOOR SYSTEM

Three reinforced precast and hollow concrete units are supported as shown until a dry-mixed concrete has been poured into the gaps and a mortar topping has been applied, making the slab a solid unit.

of the middle and end pieces projects into and loops in the gap between the precast units, as may be seen in Fig. 2. Into these gaps is poured a stiff mix of concrete which locks the tensile reinforcement and also transmits the shear and compression from one section to the other. These gaps also provide opportunity for partial two-way reinforcement when this is necessary.

Both upper corners of the units are beveled to form a trough between adjacent units near the top. These troughs provide for the grouting of the negative reinforcement and for the anchorage of the top mortar finish. The end sections have the top tapered at the bearing to permit entry under the top flange of supporting steel beams. The soffit plate is made of cinder concrete to assure a good key for plaster and maximum fireproofing; the remainder of the section which has a structural function to perform is of stone concrete.

The joints to be concreted in each bay are 9 to 10½ in. wide and 6, 8 and 10 in. deep. The units themselves are made 12 in. wide and in standard depths of 6, 8, 10 and 12 in. to provide carrying capacity for various loads

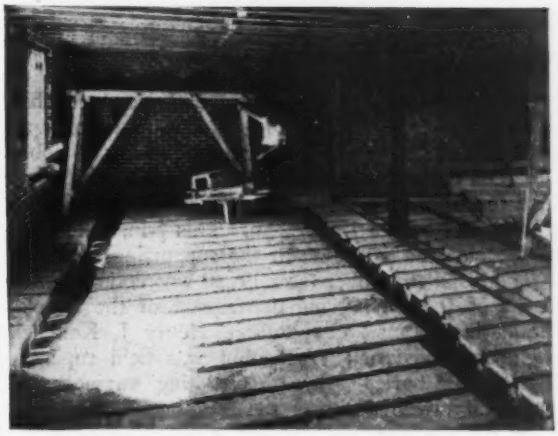


FIG. 2—UNITS IN PLACE READY TO POUR KEYWAYS AND SURFACE

Note negative reinforcing laid in beveled grooves at top. Note also the hooked bottom reinforcing, which is cast in the members.

and spans. The center units are made in one fixed length. The end units can be stocked in lengths varying by 3- or 6-in. intervals. Any odd spacing of supports intermediate of these fixed lengths can be accommodated by varying the width of the concreted joints.

Examples of Use—The first installation of this system was made in an apartment house in the Borough of Queens, New York City. The material was trucked at an age ranging down to ten days without breakage. The center units were wheeled on small hand-trucks and lowered into place with a ½-ton chain block and trolley running on a 4-in. I-beam 18 ft. long laid across wooden horses. The end units were delivered by wheelbarrows and laid in place by two men. This job, before pouring the keyways, is shown in Fig. 2.

The second installation (Fig. 3) was in a building erected over the tracks of the Brooklyn-Manhattan Transit Corporation in Brooklyn. At this location the four-track railroad is in an 18-ft. cut between concrete retaining walls 51 ft. apart. Steel girders spanning between the retaining walls were set 17 ft. apart, and the precast beams were installed across these spans to form the first floor of the building. For this job the three units were joined into one beam at the casting yard and the complete span was set in place directly from the delivery truck by a crane standing on the supporting steelwork. The beams, which were 16 ft. 8 in. and 17 ft. 8 in. long, were trucked about 12 miles without injury. After the beams were all set, the entire area was covered with

FIG. 3—PRECAST FLOOR CONSTRUCTION OVER A SUBWAY CUT

a topping of ¾-in. mortar, which acted to finish the deck and grout in the negative reinforcement.

The apartment house installation was designed for a live load of 40 lb. per square foot, and a load test showed a deflection of $\frac{1}{16}$ in. on a 15-ft. span under an applied load of 160 lb. per square foot. The second job was designed for a live load of 120 lb. per square foot and a load test showed a deflection of ⅛ in. under 240 lb. per square foot on the 17-ft. span. This ⅛-in. deflection included also the deflection of the supporting steel beams.

The installation over the railroad was under the supervision of the engineering department of the Brooklyn-Manhattan Transit Corporation, Henry J. Kolb, chief engineer. Frederick Wackenhut was field supervising engineer. Charles Mayer, consulting engineer, New York City, who designed the building, supervised the work for the owners. The writer was in charge of the design, production and erection of the work for the Pre-cast Floors Corporation, the contractor.

Rebuilding Power Plant No. 2 After the St. Francis Dam Break

Flood 125 Ft. Deep—Much Equipment Salvaged From Débris—First Unit Ready in Three Months—Nine-Day Pour on Walls

THE battered hulks of two 17,500-kva. generator units were all that remained above ground level at the San Francisquito power house No. 2 after the flood that followed the St. Francis dam failure, in March last year. This flood, sweeping down the narrow canyon with a water depth of 125 ft., completely demolished the reinforced-concrete power house, and the wreckage, including all the power-house equipment except the main units, was carried away and buried deeply in detritus. The problems of rehabilitation under these novel conditions and the methods used in reconstruction were described in a paper before the Los Angeles Section, American Society of Civil Engineers, by H. C. Gardett and A. R. Arledge, engineers of the Los Angeles Bureau of Power and Light. The following has been taken from their paper.

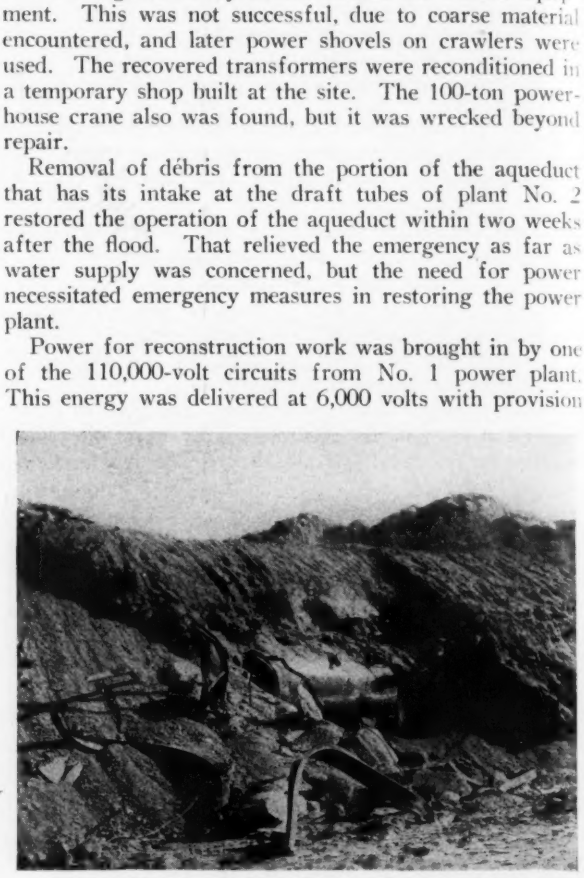
Determining the extent of the damage and the possibility of finding and reconditioning at least some of the missing equipment were the first work of rehabilitation. The penstock, supported on concrete piers and firmly anchored into bedrock at the lower end, had remained intact, though badly dented. The hydraulic turbines are of the vertical-shaft type, and being located about 25 ft. below ground level, with foundations in bedrock, were not seriously damaged. The two generator units remained on their foundation, but all accessories had been swept away and many of the minor parts broken or bent.

The first work of reconstruction was to provide a means of transportation. The road up the canyon had been completely swept away and it was six weeks before this was put into condition. In the meantime the old penstock tramway was repaired to form a skidway, which was operated by a gasoline hoist at the top to lower material and equipment. A tent camp was installed at the site the second day. More permanent camp buildings were constructed at Los Angeles in sections and were brought to the site and assembled as soon as the road was completed.

Much of the equipment lost with the power house was found scattered and buried in a gravel bar formed by a huge eddy in the flood about 300 yd. from the plant. Seven transformers weighing 30 tons each when filled with oil were located here, buried at depths ranging up to 15 ft. Before excavating equipment could be spared for this reconstruction work, an attempt was made to sluice the gravel away in the search for buried equipment. This was not successful, due to coarse material encountered, and later power shovels on crawlers were used. The recovered transformers were reconditioned in a temporary shop built at the site. The 100-ton power-house crane also was found, but it was wrecked beyond repair.

Removal of débris from the portion of the aqueduct that has its intake at the draft tubes of plant No. 2 restored the operation of the aqueduct within two weeks after the flood. That relieved the emergency as far as water supply was concerned, but the need for power necessitated emergency measures in restoring the power plant.

Power for reconstruction work was brought in by one of the 110,000-volt circuits from No. 1 power plant. This energy was delivered at 6,000 volts with provision for restoring the line to 110,000-volt service in emergency, especially during the peak-load periods. Transformers were brought from Los Angeles to step down from 6,000 to 440 volts for the 350 hp. of construction equipment in use at No. 2 power house. This arrangement was used until unit No. 1, the least damaged generator unit, was again in service.

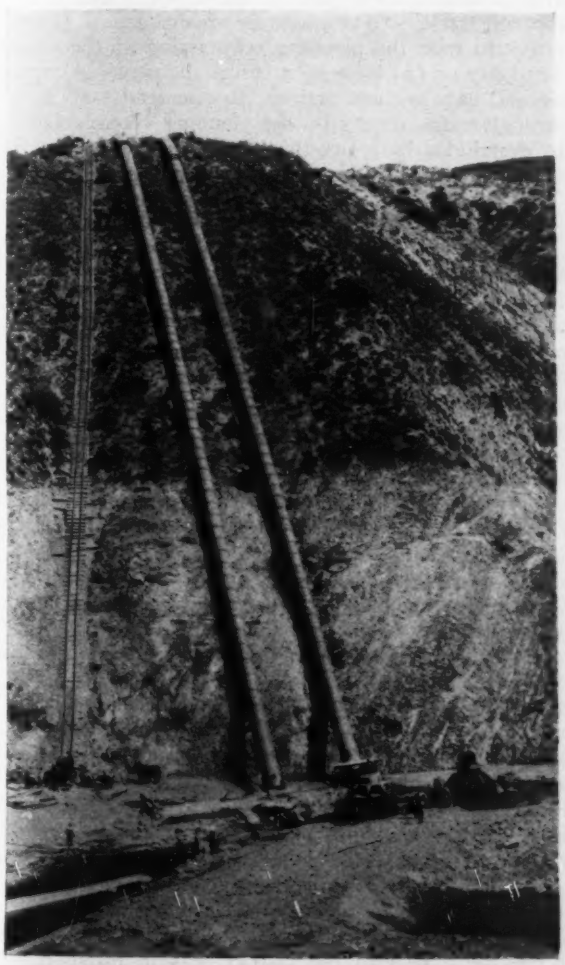


THIRTY-TON TRANSFORMERS IN GRAVEL BANK
Buried as deep as 15 ft. the seven transformers were all salvaged

Unit No. 1 was not in operation at the time of the flood and its moving parts received only the abrasion of the débris in the floodwater. The waterwheel, wicket gates and Johnson valve were intact, having been protected by the foundation and turbine-room structure that inclosed them. The stator was jacked up and cleaned and the windings were repaired; the rotor windings received the same treatment. A motor-driven exciter recovered from the mud in the turbine room, where it had lodged when the generator flood collapsed, and a new governor completed the temporary repairs. After a long drying-out period the unit was put back on the line, using the repaired transformers and a temporary outdoor switching station, three months after the flood. The second unit was in service about seven months after the flood.

In rebuilding the power house speed was a controlling factor, because the badly damaged No. 2 unit could not be reconditioned without the aid of the overhead crane. The turbine-room walls and foundation were removed for about half their depth because of cracks in the east and north walls. The west wall had tilted slightly, and this was heavily reinforced with concrete beams and floor slabs, thus tying the foundation solidly together to receive a new superstructure. After considering the establishing of a modern arrangement of outdoor switching and transforming equipment it was decided that the more economical plan was to reconstruct along lines of the original plant as nearly as practicable. The original building design was changed to permit the use of the so-called "slip-form method" for building the concrete superstructure, and the walls and frame were strengthened to support the weight of the modern switching and transforming equipment.

The large banks of gravel newly deposited close to the site were unsuited for aggregate because of the wash from the hillsides and the material from tunnel spoil dumps that was carried down by the flood. Aggregate was brought about 8 miles from a granite quarry above No. 1 plant. Sand was obtained partly from this same location and partly from a sand bar formed by the flood below plant No. 2 where the widening canyon had allowed natural segregation of the débris.



ALL THAT REMAINED AFTER THE FLOOD
Power house gone, generators in place. Note the flood mark on canyon wall.

POWER PLANT IN OPERATION AGAIN SEVEN MONTHS LATER
New power-house walls built in nine-day continuous pour.

For the power-house structure itself use was made of a patented method of slip forms made up in a continuous band of ordinary lumber forms 4 ft. high designed to include all walls and partitions. These forms were arranged to be jacked up gradually during a continuous pour by use of special jacks and yokes held by 1-in. steel rods resting on the foundation at regular intervals around the building walls. Runways for concrete buggies were laid on the yokes and were raised as the forms went up. Work proceeded in two twelve-hour shifts and the building walls were raised by a continuous pour that progressed in regular rotation around the building. Men followed the pouring operation and turned the jacks at regular intervals. The forms were raised at five- to ten-minute intervals, the rate averaging about 3 in. per hour. This method required close co-operation among pipe men, conduit men, electricians, reinforcement men and in fact the entire crew, to assure uninterrupted building progress. The work progressed without a hitch, however, and the power house structure, about 85x125 ft. in plan and 60 ft. high, was carried up to coping height in one continuous pour that lasted nine days.

Unit No. 2 was running when engulfed by the flood and continued to run for three hours thereafter without lubrication, under a torrent of silt and gravel-filled water. Considering this hard use, the waterwheel repairs were simple and not extensive. The scroll case, speed ring and those parts embedded in concrete were undamaged with the exception of some small replacements in the castings of the relief valve. The shaft was scored and had to be turned down, and the runner was replaced by a spare that was on hand in the turbine room before the flood. The generator field coils were removed to Los Angeles and rebuilt; the stator coils, damaged beyond repair, were junked and replaced.

New Railway for South Dakota

About 36 miles of grading and 3 miles of track have been completed for the 66-mile line of the Mound City & Eastern Railway, which will extend from Leola, S. D., on the Minneapolis & St. Louis Railway, due west to Mound City, through agricultural country. For preliminary financing, farmers contributed about $200,000 and negotiations are under way for permanent financing.

Charter Draft for Consolidated City of Pittsburgh

Would Combine Major Services of Allegheny County and Its 123 Cities, Boroughs and Townships Under a Federal Plan Which Would Not Disturb Boundaries and Local Functions of Existing Municipal Divisions

A CONSOLIDATED city of Pittsburgh, "Composed of Allegheny County and the Cities, Boroughs and Townships Thereof Under a Federal Plan" is provided for in a bill introduced in the Pennsylvania Legislature on March 11. Except for public works and services county wide in scope or which might readily become so, the 123 existing city, borough and township areas and governments are left undisturbed. The county would remain as a governmental unit, but for the most part its public works and services would be transferred to the consolidated city of Pittsburgh, while all legislative and most of the administrative functions now exercised by the county would be transferred to the consolidated city. A few of the present county offices, wholly administrative in character, would be continued—sheriff, coroner, controller (who would serve the consolidated city), district attorney, prothonotary, chief of courts, registrar and recorder of deeds. These officers would be elected at large. The county court would not be affected, but in place of local municipal courts there would be a single court, with branches, for the consolidated city. The educational system is not even mentioned in the charter draft. Under the charter as drafted, all the property and indebtedness of Allegheny County and the poor districts thereof, as well as such property and debts of the cities, boroughs and townships of the county as relate to the powers and duties of the consolidated city, would be transferred to the latter. The existing city of Pittsburgh would continue under that name (as distinguished from the consolidated city of Pittsburgh), but with power to adopt another name. Provision is made for the consolidation of two or more cities, boroughs or townships into one, by a majority popular vote in each division.

Pittsburgh now has an area of 49 square miles; Allegheny County, 725 square miles. The corresponding populations are about 675,000 and 1,315,000.

Referendum Provided For

If enacted by the legislature, the charter would be subjected to a referendum on June 25, 1929, and would become fully effective Jan. 1, 1930. For adoption a majority of all the votes cast in the county and at least two-thirds of the votes cast in a majority of 123 cities, boroughs and townships is required.

The charter is the work of a Commission to Study Municipal Consolidation in Counties of the Second Class, composed of 24 members: five from Pittsburgh (including Morris Knowles, consulting engineer), three from the four cities and sixteen from the 66 boroughs and 53 townships of the county. This commission first drafted a constitutional amendment, which was adopted by the electors of the state last November.

The powers of the consolidated city of Pittsburgh would include control of the following services and works: poor; juvenile offenders; health; parks and recreational facilities; through-traffic streets and bridges (defined farther on); fences, signs, billboards, buildings and other structures within 300 ft. of through-traffic streets (subject to local ordinance in municipal divisions); zoning and planning; special improvement districts for certain public works and property, serving two or more municipal divisions, but not the entire county; water supply; police; fire departments, but restricted to standards for municipal divisions and contributions in local aid, where standards are complied with; smoke prevention; traffic control; taxation and indebtedness, the latter limited to the life of the corresponding works or property; assessment for benefits; eminent domain; storerooms, parking garages, etc., as part of construction and operation of any public building; creation of offices and control of incumbents; old-age and disability retirement allowances and death benefits for employees of the consolidated city; acceptance of gifts; blanket powers necessary to carry on under the charter.

Through-traffic streets may be designated by the commissioners of the consolidated city from among existing streets and highways (other than state or state-aid roads) and in addition to existing county roads or those hereafter established by the commissioners; but no new through-traffic streets are to be created unless (*a*) they originate with the planning commission of the consolidated city or (*b*) have been before the planning commission 60 days without action. Recommendations against through-traffic streets by the planning commission may be overridden by a two-thirds vote of the city commissioners. Bridges and tunnels are included in this category.

Governed by Seven Commissioners

All powers of the consolidated city, and all powers of the commissioners of Allegheny County on Dec. 31, 1929, would be vested in seven commissioners. One of these, serving as president and being the chief executive officer of the consolidated city, would be elected at large; three would be elected from the city of Pittsburgh, as now existing or hereafter enlarged, comprising election district No. 1; and the three others one each from election districts Nos. 2, 3 and 4—No. 2 comprising the city of McKeesport, nineteen boroughs (including Braddock) and seven townships; No. 3, the cities of Clairton and Duquesne, 22 boroughs and thirteen townships; No. 4, 25 boroughs and 33 townships.

Annual budgets would be submitted by the president, based on estimates submitted to the director of finance by department heads, including administrative county officers. Once introduced, a budget ordinance would take the same course as any other ordinance of the consolidated city. The commissioners would hold office for overlapping terms of four years. Salaries would be $15,000 a year for the president and $9,000 for the six other commissioners. Election districts (except No. 1, Pittsburgh) are subject to change after each decennial U. S. Census, beginning in 1940, so as to make each district as nearly as possible of the same population, but composed of contiguous and compact population, except that where a municipal division (city, borough or township) is entirely surrounded by district No. 1 (Pittsburgh) it may be a part of the district outside Pittsburgh to which it is most nearly contiguous, measuring from nearest boundary to nearest boundary.

The only general administration officer appointed by the commissioners of the consolidated city is the treasurer. All other heads of the administrative service, except the county officers already mentioned, are appointed by the president, but subject to the approval of the commissioners. These officers may be removed by the president, on charges, after hearings, unless five commissioners vote against removal. Both county officers and department heads of the consolidated city have power of appointment of their subordinates, subject to civil service examinations conducted by the director of personnel. This official is also charged with salary classification and standardization, and with keeping a permanent employment record, including efficiency.

The president "shall have the power of direction and command, acting through the directors of the several departments, over all officers and employees of the administrative service of the consolidated city. He may at any time inquire into the conduct of any department, office or service or any officer or employee thereof."

Twelve Departments Named

Twelve administrative departments (not including commissioners of special assessment) are named: finance, health, safety, public works, welfare, parks and recreation, planning, art, personnel, law, research and information, regional transit. Others may be created and assignments and reassignments among departments may be made. Qualifications are stated for the heads of the health, public works, planning, art and regional transit departments and for division heads of some of the other departments. Eight of the twelve departments would be single-headed. The four headed by commissions are: planning, art, research and information, regional transit.

Elaboration of some of these points and notes on others concerning departments are: Under finance, there is a division of purchase and supplies. The director of health shall have been a doctor of medicine for at least ten years, and shall have power to make health regulations applicable to the whole or any part of the consolidated city. The public works department (covered in only fourteen lines of the charter draft) shall be headed by a director who "shall be an engineer of not less than ten years' professional experience." This department would supersede the existing works department of Allegheny County, the organization of which would continue to serve until altered by ordinance.

City Planning Department

The planning department is given large space in the charter draft. It would consist of a commission of nine, headed by a director who would be chairman and "who shall have had training and experience in city planning." With the advice and consent of the planning commission the director "may contract with city planners, engineers and other consultants for such services as may be required." At least six of the eight planning commissioners associated with the director shall not hold any other public office and not more than four of them shall be residents of any one municipal division. All eight would serve without pay, for terms of four years. The wide powers and duties of the planning department are thus stated in the charter draft:

Section 4. The planning department shall have charge, control and direction of all basic, geodetic, topographic, street and boundary-line surveys throughout the consolidated city, to the end that the local surveys of municipal divisions shall conform to certain standards as to character, completeness and accuracy. It shall be the duty of the planning commission to make, adopt and enforce a master plan either as a whole or in major sections, from time to time, for the physical development of the consolidated city and of any land outside its boundaries which, in the judgment of the planning commission, bears relation to the planning of such consolidated city. Said plan or plans with the accompanying maps, plats, charts and descriptive matter shall show the recommendations for the future development of said territory, including, among other things, a major street plan and the general location and character of viaducts, bridges, subways, tunnels and overhead or underground structures; of waterways, waterfronts, boulevards, parkways, parks, playgrounds, aviation fields and other open spaces; the location of public buildings and other public property of the consolidated city; the conformability therewith of the facilities of public utilities; and the relocation, vacation, moving, widening, narrowing, abandonment, change of use or extension of any of the foregoing; also a general zoning for the control of the height, area, bulk, location and use of buildings and structures and the occupation and use of land. It is the intent of this section that the location, relocation, extension, moving or abandonment by public service companies of their facilities shall, subject to the provisions of Sec. 19 hereof, be co-ordinated with the master plan.

The master plan may be adopted either as a whole or in successive "parts corresponding with major geographic sections or divisions of the consolidated city or with functional divisions of the subject matter of the plan," but in any case not until after public hearings. Once a master plan or parts of one has been adopted it must be conformed to as regards all public works, buildings and utilities, except as overruled by a two-thirds vote (six of nine) of the commissioners of the consolidated city.

Zoning throughout the consolidated city is placed under the planning commission, except that existing zoning regulations of municipal divisions shall continue in force. Where no such regulations exist in any municipal division, they may be enacted locally up to Jan. 1, 1933, in accordance with standards set up and amended by the planning commission of the consolidated city.

The jurisdiction of the planning commission over land subdivisions shall extend 5 miles outside the consolidated city but shall not include land in any outside city or borough, while in case of townships within 5 miles of any city or borough having a planning commission the jurisdiction of such commission and of the planning commission of the consolidated city shall terminate at a boundary line equally distant from the corporate limits of such municipalities.

Other Departments

The art department would consist of an art jury of nine unpaid members, with six-year terms, which would take over the work of the existing Pittsburgh Art Commission. The art jury would include a sculptor, a painter, three architects and one landscape architect, "all of eminence in their respective professions," and "three representative citizens, familiar with the fine arts but not professionally or commercially engaged therein."

The function of the department of research and information, an unpaid board of nine members, serving without pay for six-year terms, would be to appoint a director, if it saw fit, and to recommend to the commissioners, the several boards and officers of the city, improvements in administrative practice and organization, to give advice on request, and to gather information and statistics related to the government of the consolidated city.

The department of regional transit would be headed by seven commissioners, including a director appointed by the six others who must be an engineer of at least ten years' experience. This body would succeed the present transit commission of Pittsburgh.

Passing to the municipal divisions of the consolidated

city, now 123 in number, there may be added to what has already been said as to their possible consolidation one with another that the governing body of any of these divisions may propose to the commissioners of the consolidated city that the latter take over one or more of the powers of the municipal division, in which case the proposal may be accepted or rejected. If accepted, the commissioners must attach to the acceptance such terms and conditions as the charter shall prescribe, together with such other conditions as they see fit. Action does not become final, however, until the proposal, as accepted and conditioned, is approved by a majority of those voting at an election called for the purpose.

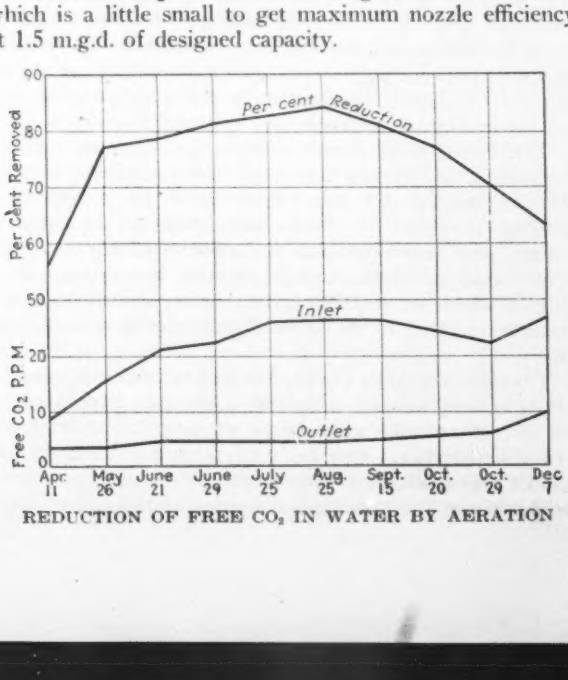
Spray Aerator for Filtered Water at Waterford, N. Y.

First Season's Operation Shows Reduction of Taste and Odor and Soda Ash Dosage to Control CO_2 and Corrosion

By R. G. Yaxley
Superintendent Water-Works, Waterford, N. Y.

INSTALLATION of a spray-type aerator to treat filtered surface water at Waterford, N. Y., has reduced taste, odor and also the amount of soda ash used to correct the corrosive action of the water. The supply is taken from the Hudson River above its junction with the Mohawk and is a soft, highly colored water, badly polluted with paper-mill wastes and sewage. The high alum dosage required for coagulation prior to filtration, together with 4 to 5 p.p.m. of free CO_2 in the river water and the low alkalinity, makes a filter effluent so corrosive that treatment is absolutely necessary to render the water suitable for distribution and use. For several years soda ash has been used successfully in the filtered water. Careful tests indicated that a spray-type aerator would save enough soda nearly to pay for the extra pumping charge, besides partly removing tastes and odors that are especially prominent during the part of the year the aerator could be used, winter operation being out of the question because of ice troubles.

Because the ground area was limited by adjacent structures, a basin 29½x64 ft. was the largest we could obtain, which is a little small to get maximum nozzle efficiency at 1.5 m.g.d. of designed capacity.



REDUCTION OF FREE CO_2 IN WATER BY AERATION

SPRAY AERATOR FOR FILTERED WATER AT WATERFORD, N. Y.

Excavation was carried down to about 20 in. below the grade of the floor slabs. After a wall 18 in. high and 12 in. thick for the side wall sub-base had been poured, 16 in. of coarse gravel was rolled in place as a base for the floor slabs. This gravel fill is provided with tile underdrains connected to a sewer to prevent frost damage during the winter months. The floor consists of eighteen slabs of equal size, about 3½ in. thick, reinforced with ½-in. deformed steel bars, 10 in. c. to c. Each slab is entirely free from its neighbor and from the wall. The joints are V-shaped, calked with dry sand in the bottom, and filled with about 3 in. of hot asphalt as a seal.

COST OF SPRAY AERATOR FOR WATER-WORKS OF WATERFORD, N. Y.

Labor	$684.73	Drain tile	$12.48
Freight and trucking	79.58	Pipes, valves, etc. (including joint material)	702.08
Lumber (for forms)	78.89	Nozzles	122.85
Contractor	870.90	Wire screen	2.24
Gravel	104.00		
Cement	54.83	Total	$2,772.87
Steel bars	60.29		

Nothing included for engineering or construction services, supplied by regular staff without interference with usual duties; nor for pump, as a spare one in place was used. Furnishing and setting cement blocks for wall and labor on laying floor slabs included under "Contractor." All other material was supplied by city and all other work done by day labor. Preliminary work, included in "Labor," required removal of about 125 sq.yd. of 8-in. concrete paving and replacing some 30 sq.yd. of it.

The wall is of standard rock-faced, concrete house blocks, laid four high and capped with concrete coping. The wall was painted with hot asphalt on the inside after completion.

The spray equipment consists of 21 spray nozzles screwed in the top of a line of cast-iron bell-and-spigot pipe extending down the center of the basin. The pipe is supported on concrete piers so the tip of the nozzle is about 2 ft. from the basin floor.

Fifteen of the nozzles are provided with shut-offs to take advantage of wind direction. Eleven nozzles will carry a load of 1.2 m.g.d. without excessive spray drift unless there is a wind, in which emergency more nozzles are used under a reduced head.

A well in one corner of the basin, guarded with a heavy ½-in. mesh wire screen and connected to the plant with 10-in. cast-iron pipe, forms the outlet. The well has a wash-out connection to the sewer. Both lines have shear gate valves set in the side walls of the well. Connections with the plant consist of about 225 ft. of 10-in. bell-and-spigot cast-iron pipe, including several fittings, also a check valve on the pump discharge.

Use of the aerator was started in March, 1928, and continued until cold weather forced a shutdown in De-

cember. Results exceed our expectations, especially in the reduction of tastes and odors during the summer and early fall. Many favorable comments on the improved quality of the water were received from our customers. The graph gives an idea of the efficiency obtained in CO_2 removal. It is of interest to note the falling off of the percentage curve as the temperature of the water went down in the late fall.

One point of especial interest is the reduction in "soap test" hardness as the water passes through the aerator. This reduction has amounted to as much as 37 per cent between influent and effluent and as yet remains unexplained. Albany, which is down the river a few miles, has a spray-type aerator also, but does not get any such results. There have been times when we were getting a 20 per cent reduction in hardness while they got only a trace under identical conditions, even with the same man, using the same test solution, making the tests.

The cost of the aerator was $2,773, as shown in detail by the accompanying table and explanatory notes.

Strict Alignment of Travel Increases Street Capacity

MUCH of the present-day traffic confusion and hazard is a direct result of improper alignment. If all vehicles were confined to fixed tracks, as are street cars, a much larger number could be accommodated on most roadways. The weaving course of vehicles causes accidents and a waste of valuable street space. The purpose of marked lanes is to increase the efficiency of roadway use and to reduce traffic accidents.

Studies of transverse distribution of traffic on surfaces of various widths in the Cleveland regional area were made to determine the width unused. The transverse distribution of passenger car, truck and bus traffic was recorded on surfaces from 18 to 40 ft. wide. The pavement width was divided into 1-ft. lanes with painted identification marks. The right rear wheel travel of each motor vehicle within the marked 1-ft. lanes was recorded.

A marked difference was noted between transverse distribution on 18- and 20-ft. pavements and on pavements in excess of 20 ft. but less than four lanes wide. On the 18- and 20-ft. surfaces more than 80 per cent of the passenger cars traveled 6 ft. or less from the edge of the pavement. On surfaces in excess of 20 ft. the greates utilization of the 6-ft. section was 46.2 per cent.

Franklin Ave., a 32-ft. surface, is used as a two-way traffic route. Traffic makes no use of 6 ft. of the pavement—that is, of a zone 3 ft. wide on each side. The same condition exists on the 32-ft. surface of Detroit Ave.; the greatest concentration of right rear wheel travel of passenger cars occurs between 6 and 9 ft. from the edges of the pavement.

In the absence of distinct lane markings, it was noted that the average distance of rear wheel travel of passenger cars from the edge of the surface on 32-, 38- and 40-ft. surfaces was more than 6 ft. On the same surface widths the average clearance of passenger cars passing in opposite directions ranges from 6.7 ft. on the 32-ft. pavement to 11.7 ft. on the 40-ft. pavement, indicating that the absence of distinct lane markings for traffic resulted in the surface being used as a two-lane route.

Abstract of report of committee on efficiency of marked lanes for wide highways presented by Leslie Sorenson, traffic engineer, Chicago, at the recent meeting of the National Highway Association.

Existing roadways more than 18 ft. wide and too narrow for four traffic lanes could therefore accommodate one additional lane of traffic by marking a three-lane route. The hours of two-lane control in one direction should be clearly indicated to the motoring public.

On many roadways the shoulders have been paved to give traffic two additional lanes at intersections. These extra lanes are generally designated for turn movements and should be clearly marked for that purpose. This same condition exists generally in congested business areas on streets where standing and parking are permitted in midblock but are prohibited for considerable distances back from the intersections. Unless these additional lanes are indicated, the use of available extra space is generally wasted by vehicles taking a middle course through the area.

Where road width permits, all left- and right-turn movements should be segregated from the through traffic into special lanes clearly marked for the particular turn; the left-turn lane should be nearest the center of the roadway and the right-turn lane nearest the curb.

A recommended standard width of lane for fast-moving vehicles is 10 ft. In emergency cases and on residential streets not subject to through traffic a 9-ft. lane could be used.

California Power 20 Per Cent Developed

California's hydro-electric power possibilities are five times larger than the present installed capacity of about 2,000,000 hp., which now produces more than 20 per cent of the total hydro-electric power in the United States, according to a 200-page report by F. E. Bonner, San Francisco, district engineer, United States Forest Service. This comprehensive study shows that 90 per cent of the total feasible water-power sites, which aggregate installations of more than 10,000,000 hp. and a continuous output estimated at more than 6,000,000 hp., are situated wholly or partly within national forests and thus will be subject to the provisions of the federal water-power act.

Major power possibilities, due to the physiography of the state, are situated largely in the northern part and along the west slope of the Sierra Nevada, leaving only 28 per cent of the total development south of Yosemite Park within economic transmission distance of southern California load centers. The Colorado River thus offers, according to the report, the logical source for supplying the rapidly increasing power demands of this section.

Wisconsin Shortens Road Patrols

Many of the road-maintenance patrol sections in Wisconsin are to be shortened, according to a report of the State Highway Division, as 15 miles is considered about the maximum that can be taken care of by a patrolman with the best motor outfit. Trouble with washboard or corrugated surface has been experienced on roads surfaced with inferior grades of gravel. Another cause is considered to be the use of very long blades on the patrol graders. Many of these machines were equipped with blades so long that the machines had to work on the sides of the road in order to leave room for traffic to pass. As a result the center of the road for 4 or 5 ft. width was worked only with the extreme tip of the blade. This was particularly noticeable on narrow roads. An effort is being made to provide patrolmen on these roads with a grader having a shorter blade, as this will allow the machine to work on the center of the road.

Form Displacement Analyzed for Practical Concrete-Workers

Part I—Lateral Displacement

Permissible Limits of Yield—Displacement Tests of Four Types of Collars—Yield Tests of Wire Ties—Loads for Wire Strands—Allowable Bearing Loads of Wood on Wood—Practical Practices

By Ambrose G. Hampton

Resident Engineer, South Carolina State Highway Department McClellanville, S. C.

THE DESIGN of forms for concrete structures is usually based on a fixed limit of deflection for the various structural members and the usual fixed working stresses for the materials used. It is believed that this practice does not produce adequate forms for all conditions and that it may be improved, first by establishing suitable limits of displacement for the many special cases that may arise, and second by analyzing the causes of form yield with a view to producing a better balanced and more efficient design.

Limits of Yield—The limits for any sudden change in a concrete surface should be $\frac{1}{16}$ in. for all ordinarily visible members and $\frac{1}{32}$ in. for rails and curbs. In a column, pier or wall the total swell in one face can be as large as $\frac{1}{4}$ in., but the swell between wales or yokes should not be greater than $\frac{1}{8}$ in. For particular work these limits should be $\frac{1}{8}$ in. and $\frac{1}{16}$ in. respectively. The limits in curbs and rails should be $\frac{1}{8}$ in. for the entire length and $\frac{1}{16}$ in. for a local swell, or preferably $\frac{1}{16}$ in., as a maximum variation from a straight line.

Lateral Ties—The devices for holding forms against lateral displacement are shores and ties. Shores should not be used to take the entire lateral pressure of a deep form unless adequate tying cannot be effected. When ties are used there are three general causes of form movement: (1) elongation of the tie, (2) compression of bearing surfaces, and (3) deflection of members acting as beams. Deflection in sheathing and wales is thoroughly covered in a number of excellent handbooks and need not be discussed.

Tests on Collars—As the amount of yield due to compression of joints cannot be calculated mathematically, a number of tests were made on different types of collars to determine empirical values for each case. The models were made to conform as nearly as possible to the average carefully built collar used on the job.

The two-bolt collar (Figs. 1*a* and 2*a*) consisted of two $\frac{1}{2}$-in. bolts through 4x4-in. timbers. Standard $\frac{3}{4}$-in. ogee washers increased the bearing area, and $\frac{1}{2}$-in. cut washers placed over these secured the proper fit on bolt head and nut. In tightening up the bolts an initial pressure of 700 lb. was imposed. The pressures indicated on the diagrams are in addition to the 700-lb. initial pressure.

At the conclusion of the tests the total load of 3,100 lb. caused these unit stresses: tension in bolts at root of thread, 12,300 lb. per sq.in.; compression across grain in timber, 221 lb. per sq.in. at timber joint, and 197 lb. per sq.in. under washers. At a pressure of 2,400 lb. the studs had moved only $\frac{1}{16}$ in., while the collar itself had yielded only about $\frac{1}{32}$ in. It is therefore a good type to use in cases where a very small yield is required.

For the one-bolt tie (Figs. 1*b* and 2*b*) the 4x4-in. wales were held at their centers by a $\frac{5}{8}$-in. bolt using standard $\frac{3}{4}$-in. ogee washers. An initial pressure of 300 lb. was used, which made the total load at the completion of the tests 2,700 lb. This caused the following stresses: tension in bolt at root of thread, 13,300 lb. per sq.in.; compression against grain of timber, 193 lb. per sq.in. at timber joint, and 400 lb. per sq.in. under washers. This type does not balance up well, as the stress on the timber under the washers is too high. The area of the washers should have been 13 to 14 sq.in.

The nailed collar (Figs. 1*c* and 2*c*) was built of 2x4-in. pieces fastened at the corners with four 20-d. nails carefully staggered and clinched. No initial pressure was put on the collar, but it was fitted up as closely as possible to the studs. The yield was high at first but

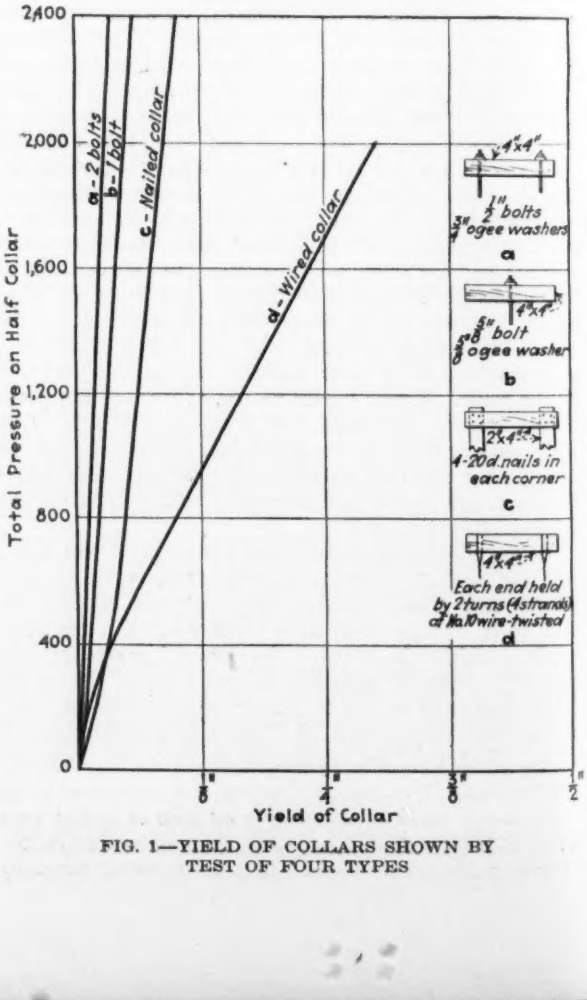


FIG. 1—YIELD OF COLLARS SHOWN BY TEST OF FOUR TYPES

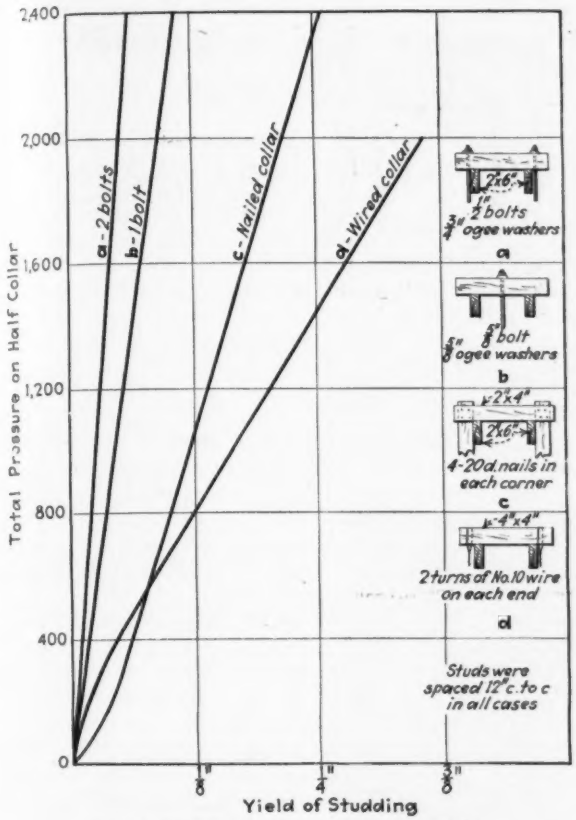


FIG. 2—YIELD OF STUDDING WITH FOUR TYPES OF COLLARS

dropped off as the joints began to take up. The collar itself held up fairly well, but the yield of the studs was relatively high. This was due to insufficient bearing area between studs and collar. It is evident that this type of collar should be limited to locations where the maximum amount of yield is permissible. At the completion of the test the total load on each nail was 300 lb. and the pressure on the timber was 390 lb. per sq.in.

The wired collar (Figs. 1*d* and 2*d*) was formed by putting the 4x4-in. wales in place and tying their ends with two complete turns of No. 10 wire. The wire was then twisted with 60-d. nails, which were fastened to prevent untwisting. This operation caused an initial pressure of 750 lb. The yield increased with the pressure, forming a descending curve that seems to be typical of wire ties. Because of the ample bearing on the timber joint the yield of the studs relative to the collar was rather low. For this reason and because of the initial stress that can be obtained, this type gives fairly good results for low pressures. As may be seen from Fig. 2, it is superior to the nailed collar when used against studding and for pressures less than 550 lb. per collar. The maximum pressure used was 2,750 lb., which caused a stress in the metal of more than 24,000 lb. per sq.in.

There are a number of patented devices to be used in connection with wire ties, and all of these that tend to increase the bearing area on wood are advantageous. Even in these cases there are two distinct disadvantages to the use of wire as a form tie: (1) It is almost always overstressed, as few seem to realize how small the metal sections are; the tension in annealed wire should be kept down to 20,000 lb. per sq.in., which is about 280 lb. per strand of No. 10 wire. (2) It is apt to be stretched by workmen climbing in the form, and when it passes through the concrete it is sometimes cut by the spading.

Tests on Wire Ties—The tests on wire ties, the results of which are shown by Fig. 3, were made in co-operation with F. K. Plough, at that time resident engineer on the Wateree River bridge. As there are two general methods of fastening wire, a test was made of each. The curves marked *A* indicate the yield of a tie made with a lapped joint—similar to the joints made in telephone lines where each end is twisted about the other strand. Curves marked *B* show the yield of a tie made with a link joint where each strand is doubled back and twisted about itself. With the largest wire (No. 8) the lap splice was not effective, as the wire was apparently too stiff for such a connection. The *A* ties were also hammered carefully to the sides of the timbers, whereas the *B* ties were left rounded. This accounts for the slight advantage of the *A* ties in sizes 12 and 14, but the difference is not so much as might have been expected.

The following table gives the recommended load per strand and the bearing area on wood per strand of the more common sizes of wire:

Gage No.	Area (B. W. G.)	Load Per Strand (16,000 Lb.)	Bearing on Wood Per Strand
8	0.0214	342	1.71
10	0.0141	226	1.13
12	0.0093	149	0.75
14	0.0054	86	0.43

Discussion of Tests—We find that the taking up of joints and the compression of timber across grain are the chief elements of yield; also that this yield increases directly with the pressure, though at a different ratio for the different types of collars. In calculating the intensity of pressure required to cause $\frac{1}{64}$ in. of yield at the timber-on-timber joints the collars were found to rate as follows:

1. Type a, 95 lb. per sq.in.
2. Type b, 65 lb. per sq.in.
3. Type d, 47 lb. per sq.in.
4. Type c, 39 lb. per sq.in.

It is believed that this variation is due chiefly to the manner in which the load is distributed over the bearing area. In the case of the nailed collar (Figs. 1*c* and 2*c*) the members were held eccentrically, which caused them to twist under the load. This made the timber bear on only one edge, which decreased the contact area and increased the yield. The wired collar, *d*, although apparently well balanced, seemed to have a tendency to twist as the wire cut into its edges. Then as the yield increased the testing levers began to assume a sloping position, which caused a new eccentricity. If the loading device had been arranged to remain in a horizontal position, this condition might have been improved. In the one-bolt tie, *b*, the deflection of the 4x4-in. wale tended to produce a slightly uneven bearing, but in other respects its load distribution was good.

Although it seems that the advantage of the two-bolt collar, *a*, over the other types is more than the conditions warranted, it is nevertheless true that its load distribution was almost ideal and that it never yielded enough at any time to cause an appreciable slope of the levers. In considering the yield of the various connections it should be noted, too, that in cases where the pressure across the grain did not exceed 220 lb. per sq.in. the yield of the joint was not excessive. It is therefore recommended that 200 lb. per sq.in. be used as the limit for such stresses in all cases where small displacement is desired.

It is evident that the elongation of the tie is of no importance so long as ordinary working stresses are adhered to. In the connection of the tie to the wale,

however, it is necessary to provide a sufficient bearing area on the timber. This area should preferably be such that the maximum pressure per square inch is not more than 200 lb. In model *a* extra large washers were used to increase the bearing area and cut washers had to be used under bolt and nut. In "Structural Members and Connections," by Hool and Kinne, the authors are opposed to the use of oversized washers because of poor bearing of bolt head and nut and because of the fact that workmen are prone to put on the standard sizes. They give a list of steel plate washers that will produce 350 lb. per sq.in. on the wood for 16,000 lb. per sq.in. on the bolt. Although these washers were designed to produce a desired strength, they are undoubtedly advantageous in controlling yield. In formwork such special devices may be used many times and their first cost is therefore not so important as it is in the case of permanent work. The following sizes are therefore suggested, based on a pressure of 200 lb. per sq.in. on wood for 16,000 lb. per sq.in. on the bolt at root of thread:

Size of Bolt, In.	Capacity of Bolt, Lb.	Size of Washer, In.	Thickness of Washer, In.	Weight Per 100 Washers, Lb.
½	1,088	2½ sq.	1/16	48
⅝	2,018	3½ sq.	¼	105
¾	3,230	4 sq.	5/16	233
⅞	4,830	5 sq.	⅜	323
¾ on 4-in. timber	....	4x6½	½	412

Effect of Form Displacement—To illustrate the importance of an accurate estimate of form displacement at the critical points of a structure, consider the case of a column with a construction joint 4 or 5 ft. from the top. The form system shown in Fig. 4 would seem amply stiff for a 4-ft. head of concrete, as the sheathing would deflect only about 3/64 in. and the collars only about 1/16 in. With the joint located as shown, however, the total yield

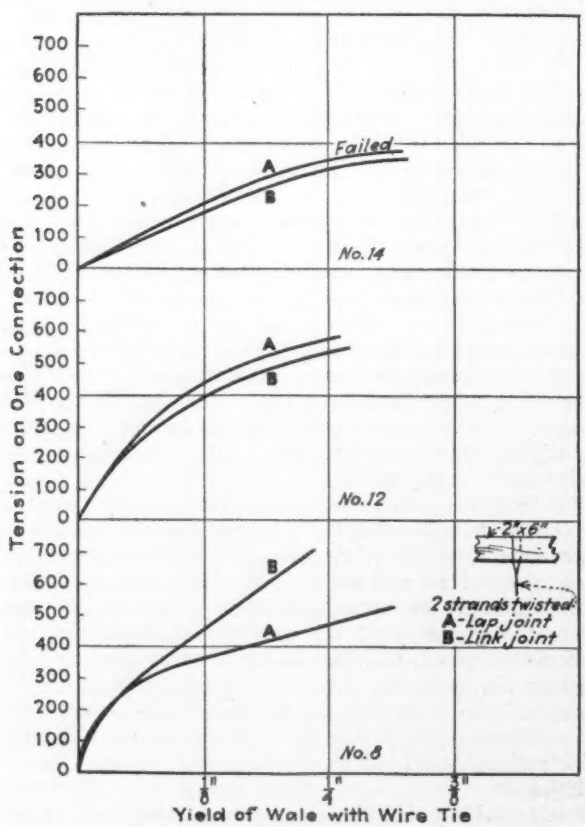


FIG. 3—YIELD OF WIRE TIES WITH LAP JOINTS AND LINK JOINTS

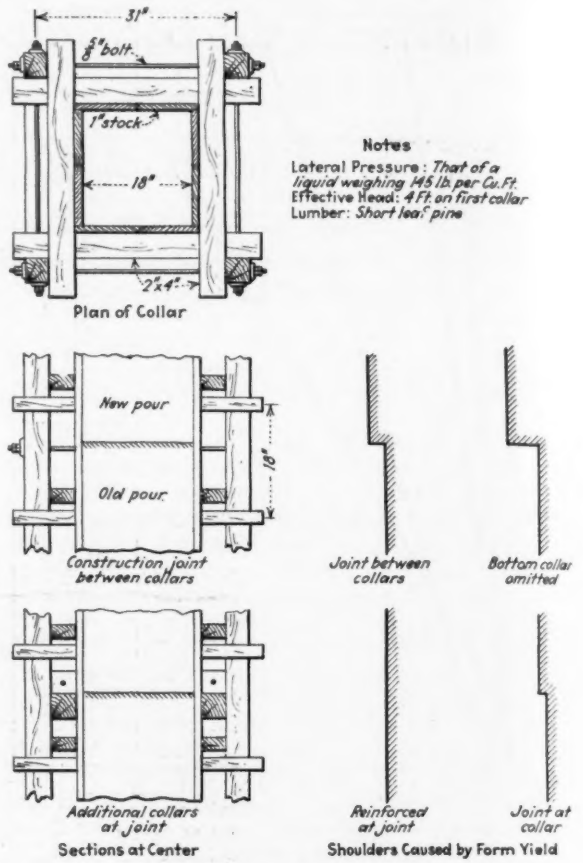


FIG. 4—COLLAR ARRANGEMENT AT CONSTRUCTION JOINT

of one side of the form at that point would probably be as follows:

Compression and deflection of sheathing	2/64 in.
Deflection of collars	3/64 in.
Take-up of joints in collars	3/64 in.
Total	¼ in.

If the collar below the joint were left loose or were omitted, as is often done, this yield would be almost ¼ in. This condition would have been improved by having the construction joint come at a collar, in which case the total yield would only be 1/16 in. Or, if the location of the joint between collars were unavoidable, the displacement might be controlled by placing collars similar to model Figs. 1*a* and 2*a* directly against the sheathing. The total yield would then be less than 1/64 in. It is evident that any form movement at a construction joint will create a shoulder in the concrete surface, as shown in Fig. 4. Thus the appearance of a column may be damaged or even ruined by the accumulation at one point of several seemingly trivial displacements.

Road and Bridge Program for British Columbia

British Columbia plans to spend $7,100,000 during 1929 on roads and bridges and $2,500,000 for maintenance, it is announced by the Minister of Public Works. Special provision is made for the construction, reconstruction and permanent improvement of trails and bridges required as access to the more important mineral areas within the province, $1,000,000 being set aside for this purpose.

Mechanical Car-Washers in Railway Yards

Labor-Saving Machines in Use by Steam and Electric Railways Here and Abroad

INSTALLATIONS of car-washing machines by steam and electric railroads in this country and abroad seem to promise a reduction in the tedious, expensive and unpleasant work of washing the exteriors of passenger cars by hand. The introduction of such mechanical washing plants may also affect the track layout of coach yards, in order to facilitate the handling of cars to and through the machine and then back to the storage tracks.

Baltimore & Ohio Railroad—Two washing machines have been installed by this road, one at Baltimore and the other at Pittsburgh. In the former case, the machine had to be placed on a track with Y-connections to the coach yard, this being the only location available. Trains from the Camden station are taken to the coach storage yard and then over the Y-track to the car-washing track, where they are pulled or pushed through the machine. After the washing, which takes about fifteen minutes for a ten-car train, the train is returned over the Y-track to the coach yard.

The equipment includes a scrubbing machine and a washing machine, shown in Figs. 1 and 2. In the former, which is the first to be engaged by the car, there is on each side of the track a structural-steel frame carrying a 5-hp. motor which furnishes power to a vertical reciprocating frame on which are mounted nine 6x30-in. flat bristle brushes. This brush frame has motor-driven mechanism for horizontal adjustment to accommodate cars of various widths and to allow for wear of the brushes. A tank on the ground contains a cleaning compound or solution and extends far enough to catch surplus solution dripping from the brushes and the side of the car. A small rotary pump delivers this compound to a horizontal perforated pipe above the top brush and also to pipes at the sides of the machine, so that the side of the car is thoroughly covered with the cleaning solution while the brushes are in operation.

For the washing machine, which is just beyond the scrubber, there are two vertical steel frames, each carrying three vertical revolving brushes. Each brush is mounted on a swinging frame actuated by springs, so as to hold the brush in contact with the irregular contour of the car or to swing it clear to allow for the return of the train or the passage of the locomotive. The top brush cleans the letter board, the middle brush cleans the windows, and the bottom brush cleans the side below the windows. On each swinging frame is a 2-hp. motor which through spur gearing drives the brush at 300 r.p.m. Water at 60-lb. pressure is supplied to vertical perforated pipes and sprayed against the side of the car to remove all dirt and cleaning solution. A drain pit with sewer connection disposes of the water. The first spray pipe is in advance of the brushes, so that the surface of the car is wetted before the brushes engage it. The water from the rear pipe rinses the surface after the brushing. When washing by the revolving brushes only, it was found that their action in combination with the cleaning solution quickly wore away the varnish if the car came to a stop while being washed. For this reason the scrubber with reciprocating brushes was designed. It is not always used, however, but is operated when desirable to clean cars having such an accumulation of dirt as to require more thorough cleaning than can be given by the washing machine only.

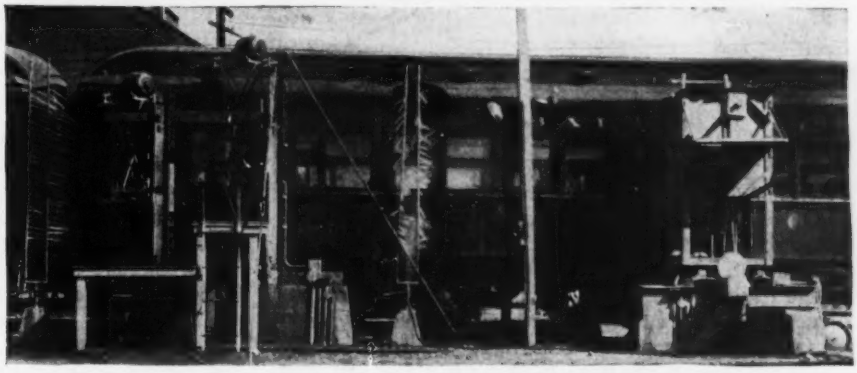


FIG. 2—CAR PASSING THROUGH WASHING MACHINE
Car moving to left passes scrubber first, then vertical spray pipe, then revolving brushes and finally the spray pipe at left of picture.

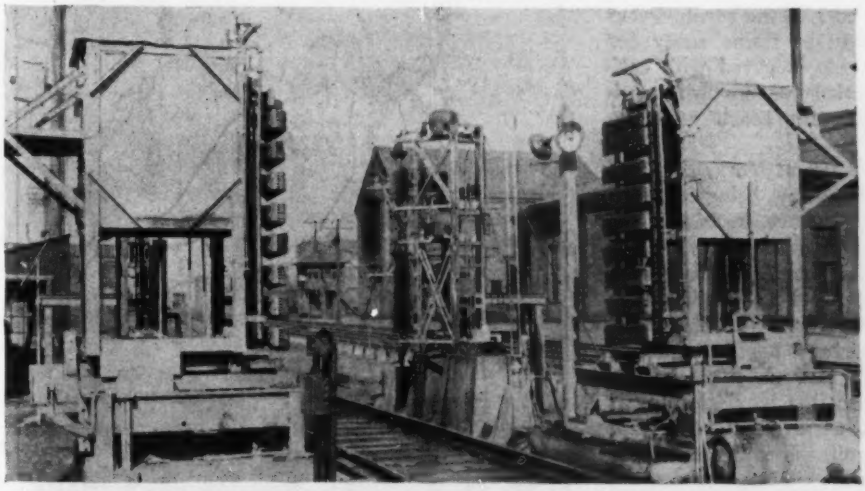


FIG. 1—CAR-WASHING MACHINE, BALTIMORE & OHIO RAILROAD
First section or scrubber has flat reciprocating brushes. Second section has three vertical revolving brushes.

Trains to be cleaned are put in position on the washing track and pulled by a cable and motor-drum, or pulled or pushed by a locomotive, so

as to pass between the sets of brushes. At the scrubbing machine, the speed is about 14 ft. per minute, whereas for the washing machine only the speed is about 25 ft. per minute. In addition to the spray pipes, there are short standpipes connected to steam and water lines so that car steps, battery boxes and all equipment below the car body can be washed by spraying. The capacity is said to be 100 coaches in an eight-hour day. Five men are required with the machine: one on each side to control the spray pipes and brushes; one to go through the train and close windows and vestibule doors; two to clean vestibules, platforms and steps by hand.

The revolving-brush washing machine was patented by A. H. Leschke, operating engineer of the Pittsburgh Electric Railway Company, which company has a washing plant for its electric cars. The car-scrubbing device was designed by W. B. Whitsitt, mechanical engineer of the Baltimore & Ohio Railroad, who has applied for a patent on this and also on a combination of car scrubbing and washing machine. This combination machine will save time and is desirable for the reason that owing to the large number of tunnels on the Baltimore & Ohio it has been found necessary to scrub the cars after every three or four trips.

Methods Used in France and England

Foreign Car Washers—At its extensive coach yards at Ourcq, 4 miles from Paris, France, the Eastern Railway has a car-washing machine served by a special track layout. Incoming trains are placed on a set of storage tracks, from which they pass over inspection pits to another group of tracks connected with the one washing track by a series of crossovers. An engine pulls a train along the track at 1½ to 2 m.p.h. The cars pass first between vertical perforated pipes, from which jets of water are applied at different angles and under 56-lb. pressure. They next pass between four pairs of revolving cylindrical mops or washers over which streams of water are running. The mops consist of hundreds of strips of cloth or felt about 4½ in. wide and 2 ft. long, attached at one end to the cylinder and flying out by centrifugal action so that with the whirling motion they forcibly wipe the sides and windows of the cars. Four of the cylinders are 8½ ft. high; the others are 11½ ft. high on account of the double-deck cars used in the Paris suburban traffic. The cars pass finally through another set of water jets and then go either to the repair tracks or to the storage tracks assigned to trains ready for service. The track at the machine is paved with concrete and well drained. This track layout involves much more switching than is desirable for coach yards on American railroads.

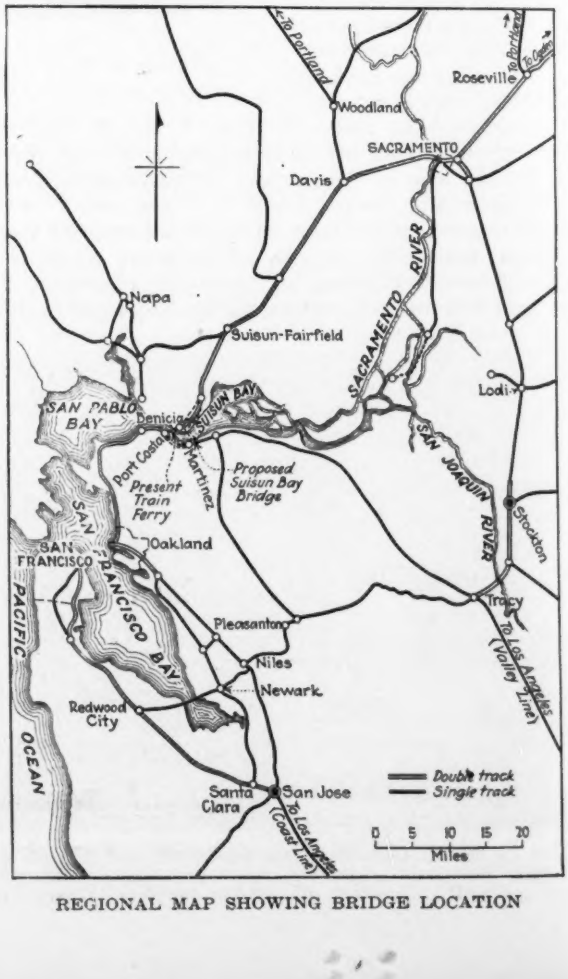
A somewhat similar plant is in use at York, England, on the London & Northeastern Railway, being equipped with the revolving mops described above, instead of the brushes used on the installations in this country. They revolve at about 50 r.p.m. A switch engine pulls a train of cars through the machine at about 1½ m.p.h. It is stated that no hand wiping is necessary after this treatment, even for the windows or the brass handles of doors, and that the operation has no injurious effect on the paint or varnish. It is stated also that hand cleaning is not entirely effective, and that as a result at certain periods, under the ordinary system, the cars have to receive a special washing with acid solutions to remove grease and dirt thoroughly. The efficiency of the machine work is said to eliminate the necessity for such extra hand washing.

Open Caissons for Deep Piers on Suisun Bay Bridge

Southern Pacific Double-Track Bridge to Have Piers 214 Ft. High—Design Makes Allowance for Earthquake Shocks

AFTER operating train ferries for 50 years across Suisun Bay, an arm of San Francisco Bay, the Southern Pacific Company has awarded a contract for the construction at that point of a double-track steel railroad bridge 5,603½ ft. long. The project as a whole includes several miles of approach grading to provide a grade of only 0.45 per cent against westbound traffic and of 1 per cent against eastbound traffic. Downgrades will be as much as 2.2 per cent to minimize track relocation. The completion of the project, which is expected to require about two years, will give to this short, direct route the advantage of through tracks that are now to be had only by a circuitous route some 46 miles longer. Announcement of the scheme appeared in *Engineering News-Record*, Aug. 30, 1928, p. 329, and approval by the War Department was noted Oct. 25, 1928, p. 636.

Studies of the foundation condition and the bridge design problem in general were made as early as 1890. In 1905 a bridge permit from the War Department was obtained, but the requirements were such as to make the cost prohibitive at that time. Under the provisions of the permit granted last year a lift span giving a channel 300 ft. wide in the clear is to be raised 135 ft. above



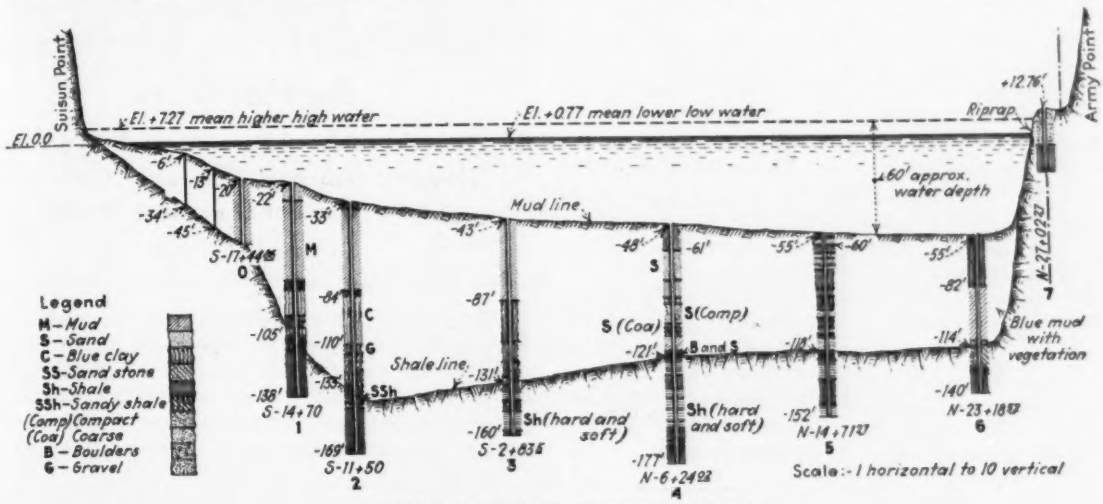
REGIONAL MAP SHOWING BRIDGE LOCATION

high water, while the clearance above the entire navigable width of the river is to be 70 ft. On this basis the cost of the project is estimated at $12,000,000.

In preliminary work on the project the Southern Pacific Company made borings and programmed as a basis of designs and estimates what seemed to be the best scheme of construction. It was not advisable to make drill borings from barges, because tidal currents here attain a velocity of about 5 m.p.h. and also because of the interference with navigation which barge anchor lines would introduce. Five drilling platforms supported on piles were therefore erected and steel cages made of four angle irons laced on four sides were driven from these into the mud bottom. Within this protection, 10-in. well casings were put down, guided within the heavy steel reinforcing in the 6-ft. concrete walls designed to take care of sinking stresses and give maximum rigidity. The caissons will be poured in the dry and will have cutting edges shod with a heavy steel shoe with a 35 deg. bevel, steel clad and filled with concrete.

The method of placing these caissons will be to sink each one within a sand-filled circular steel cylinder about 80 ft. in diameter resting on the gravel or clay stratum which overlies the bedrock. The cylinder will be placed first, being surrounded with piling and sunk gradually by building up the side walls in sections. In sinking the caissons excavation will be carried on through the six dredging wells until the bottom rests evenly on rock foundation.

The next step will be to use water jets in clearing



PROFILE AND RESULT OF TEST BORINGS

cages by diaphragms, and all drilling was done inside these wells. Results of the borings showed shale and sandstone foundation for the full length of the bridge at depths ranging from 115 to 141 ft. below mean low tide. Water depths are 25 to 55 ft., the foundation rock being overlain by mud, sand and clay.

To determine bearing values of the bottom, tests were made in several of the wells, using an extra-heavy 5-in. pipe to the lower end of which a 6x6-in. hardwood block had been fastened. The pipe was lowered in the well until the block rested on the material to be tested and the top of the pipe was approximately 3 ft. above the platform floor. Care was taken to have the bottom of the hole at least 2 ft. below the base of the 10-in. casing. The pipe was then loaded by putting water in a barrel supported on a lever, which, in turn, put weight on the test pipe through a lever arm ratio of 1 to 15. As a result of these tests it was decided that there was no material above the underlying rock itself the bearing value of which was sufficient to support a pier.

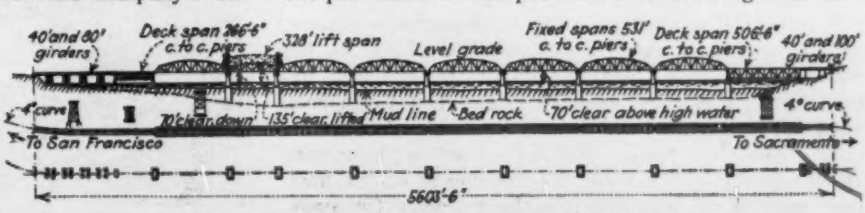
The contractor is not to be limited to any particular railroad company's construction method, but the construction plan, which has been developed in detail, is outlined in the following.

All piers will be put down in large open caissons of reinforced-concrete construction, to be sunk to rock foundation. The caissons will be 40x60 ft. in plan with

out the mud within the dredging wells, meanwhile pumping from the bottom of each well until the water is clear. It is then planned to fill each well with not less than 35 ft. of tremie concrete. This will give a pumping head of less than 100 ft. under which it will be possible to pump out each of the wells. Finally all wells will be filled with unreinforced concrete to make a solid pier.

The horizontal section of the pier at the top of the caisson, about 27 ft. below mean high water, will be 40x60 ft.; the pier shaft proper extending from this level to the height required for the bridge shoes will taper to a top section of 17x49 ft. By use of reinforcing steel the upper portion of the pier shaft is designed for the same earthquake safety factor as that part below water level.

To avoid risk of corrosion due to the action of salt water, this reinforcing steel will be embedded 2 ft. from the outer surface of the concrete. At the point where the pier section changes materially—that is, at the top of the open caisson—additional steel in the form of ties extending diagonally from the heavier section below into the pier shaft will be provided to avoid danger of dam-



PRINCIPAL DIMENSIONS OF SUISUN BAY BRIDGE

age at this point in case of earthquake. With rock foundation at the lowest point 143 ft. below mean lower low water and with bridge shoe 71 ft. above that level. the total height of the deepest pier will be 214 ft.

Before final approval of the bridge site a thorough study was made by geologists to make sure that there were no earthquake faults in the immediate vicinity. Additional precaution was taken by designing the piers to withstand earthquake shock. In commenting on this feature George W. Rear, engineer of bridges, Southern Pacific Company, said in a recent address before the San Francisco Section, American Society of Civil Engineers: "The piers have been designed to withstand an earthquake shock with a good factor of safety for a quake of twice the intensity of that occurring at Third and Market Sts. in San Francisco in 1906 and 50 per cent greater than the allowance recommended in the design of structures in Japan, where earthquakes are not only more frequent but of greater intensity than in the United States."

Location of the 300-ft. lift span was fixed by the established navigation channel. The remainder of the bridge includes eight through spans, 531 ft. long between pier centers, and a deck approach span 504 ft. long at the east end. This arrangement makes it possible to begin steel erection at the west end, building each span successively on the same steel falsework that will be floated into each span opening on barges and lowered to bearings on the concrete pier faces previously arranged at the desired level. After erection of the last through span this falsework can be barged into place in the approach span at the east end of the bridge, where it will become part of the permanent structure as a deck span.

On either side of the lift span which will be the main channel for shipping, timber guiding fenders 171 ft. long are to be provided. These are to be of the type developed by the Shell Oil Company lower down on this same waterway and will include the use of car springs in each pile near the top to absorb shocks.

The through trusses will be designed for two tracks, each carrying train loadings equivalent to Cooper's E-90, followed and preceded by a uniform load of 7,500 lb. per foot, this uniform load to be used or omitted at either or both ends of the concentrated system to give maximum stresses. In calculating the maximum stresses due to live loads and centrifugal force, both tracks are considered simultaneously loaded except that 90 per cent of the total specified live load is used.

Because this loading is greater than it is expected will actually occur, relatively high unit stresses were allowed, as follows: axial tension, carbon steel, 21,300 lb. per sq.in.; silicon steel, 32,000 lb.; heat-treated eye-bars, 36,000 lb. It is planned to make extensive use of silicon steel and heat-treated eye-bars.

Studies of the Suisun Bay bridge project have been carried on since 1925 under the direction of C. R. Harding, engineer of standards, Southern Pacific Company. Construction is to be under the joint direction of Mr. Harding and W. H. Kirkbridge, engineer of maintenance-of-way and structures. Field work is to be under the direct supervision of H. J. Benjamin, assistant engineer of bridges. The engineering firm of Moran & Proctor acted as consulting engineers on the foundation, and the lift span and towers will be designed by Waddell & Hardesty. The project as a whole was reviewed by Ralph Modjeski.

Contracts were awarded Feb. 26, 1929, to the United States Steel Products Company for the superstructure and to Siems, Helmers & Shaffner, Inc., St. Paul, Minn., for the piers. Terms of these contracts require that the piers be finished within sixteen months and the steelwork be in place within three months after the piers are completed.

Multiple-Lane Paving Job Organized for Fast Work

By Close Schedule of Paver Travel 3.78 Miles of Five-Lane Concrete Pavement, Curb and Gutter Was Put Down in 4 Months

By George W. Jones

Road Commissioner, Los Angeles County, Los Angeles, Calif.

BY EXCELLENT organization of the work a 70-ft. pavement scheduled to require six months for construction was completed on Long Beach Boulevard, Los Angeles, last summer in about two-thirds of the contract time. Outstanding as a factor in the fast construction was the careful synchronizing of excavation and sub-grade preparation with the mixer progress and with a maximum of road left clear for traffic. Routing and time scheduling of two mixers were also factors which contributed largely to fast construction.

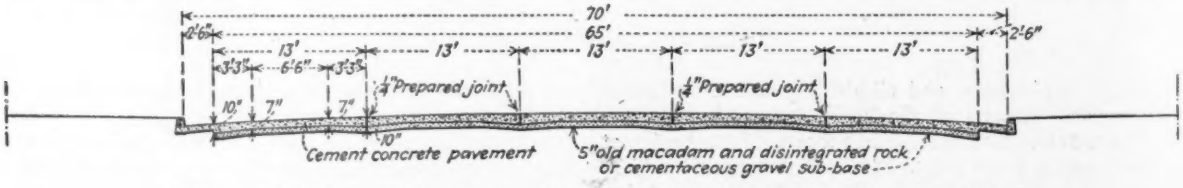


FIG. 1—STANDARD FIVE-LANE PAVEMENT, LONG BEACH BOULEVARD, LOS ANGELES

Work Undertaken—Long Beach Boulevard is one of

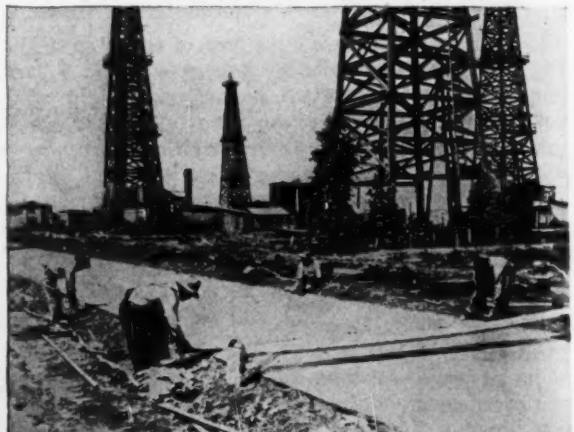


FIG. 2—PREPARING TO PULL CAP OF PREPARED TRANSVERSE JOINT

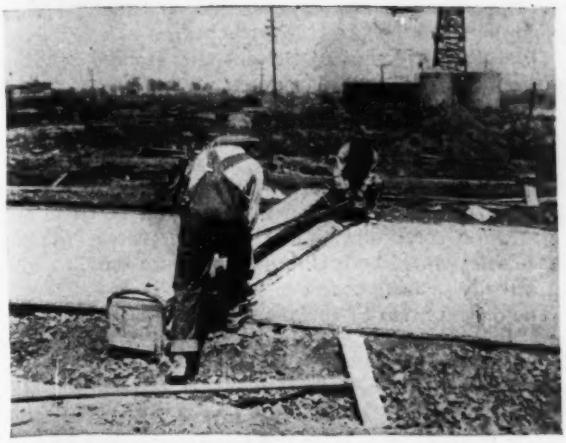


FIG. 3—JOINT CAP REMOVED, LEAVING CONCRETE EDGES TORN

the 100-ft. boulevard projects of Los Angeles County. The last link, 3.78 miles long, is the work referred to here. It in brief comprised the construction of curbs, gutters, some sidewalks and concrete pavement on a disintegrated rock and old macadam base 5 in. thick. As shown by Fig. 1, the paving slab proper consisted of five 13-ft. strips, of 10-7-10 in. section. The contract quantities were: excavation, 62,000 cu.yd.; curb, 37,000 lin.ft.; gutter, 100,000 sq.ft.; pavement, 1,300,000 sq.ft., and storm drain and other underground work.

The concrete was 1:2:4, produced and placed according to usual good paving practice. The finishing was

FIG. 4—FLOATING ROUGHENED JOINT TO NEW FINISH

rather exacting. Following a regulation finishing-machine tamping and belting, a straight-edge templet 15 ft. long with a 6-in. troweling surface was worked across the slab from bridges, and then came two beltings by hand, using coarse and then fine canvas belts. Joints were finished with floats and trowels and then rounded with edgers. The slab was covered with burlap as soon as it was stiff enough. This was kept wet and the following morning was covered with a second layer and both were kept wet for fourteen days. Then the slab was uncovered and left to cure in air seven days before traffic was allowed. The views Figs. 2 to 5 show joint finishing and troweling operations, and Fig. 6 is a view of the finished road.

Grade Preparation—The rough grading was done with a 1-yd. power shovel loading into dump trucks after the old macadam had been broken up with a 60-tractor and a five-point rooter and had been bladed to one side with a No. 12 road grader. This material was reclaimed and put back on the grade for sub-base. Also for the same purpose disintegrated rock was hauled in from quarries 18 miles away.

As mentioned previously, the main feature of the grading was its systematic planning. This may sound like a silly explanation of the contractor's success in keeping his pavers working continuously, but it is the correct explanation and deserves to be noted. It is found often that contractors give so much thought to efficiency in mixing as to fail to realize that before the paving agency

FIG. 5—TROWEL MEN SMOOTHING SLAB EDGES NEXT TO FORMS

can become effective they must have a place on which to put pavement. On this operation the contractor had computed to within a few feet how many feet of grade he could prepare in a given time with the crew available. Thus he never delayed the mixers nor did he have an excess of street torn up at any time.

Paving Procedure—The pavement was constructed in five 13-ft. strips with ¼-in. prepared joints between them, as indicated by Fig. 1. Each strip was laid down by regulation concrete-paving methods, using 27-E pavers and standard finishing machines. Nor was there anything special in handling materials. Aggregates were brought from commercial bunkers at Long Beach, 3.8 miles away, in dump-truck batches, and cement was dumped on the subgrade and rehandled into three-bag piles for charging by hand to the mixer skip. About the

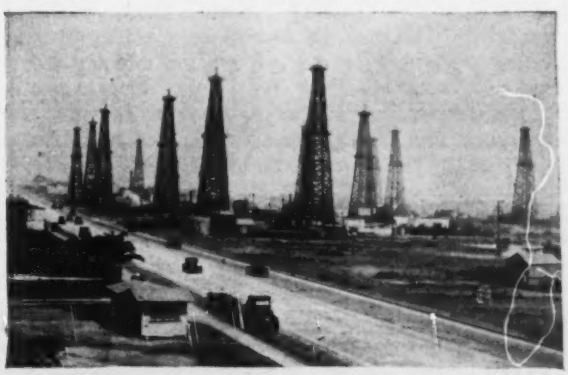


FIG. 6—SECTION OF FINISHED FIVE-LANE PAVEMENT

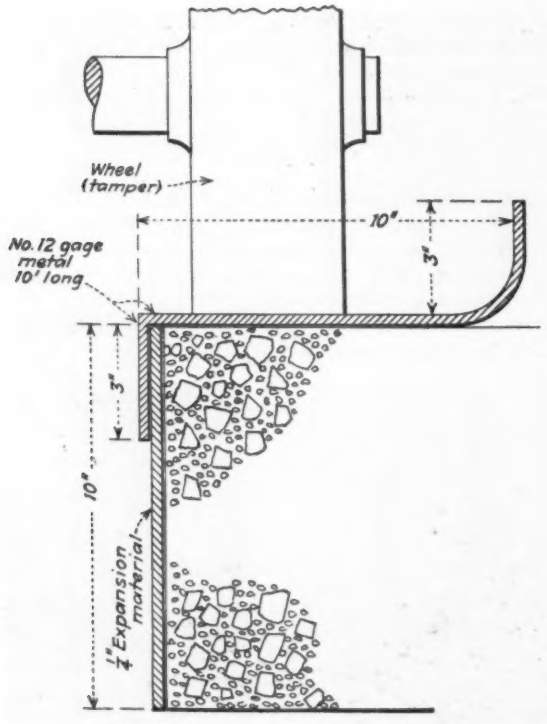


FIG. 7—METAL TRACK AND JOINT PROTECTION PLATE

only special device was the longitudinal edge strip (Fig. 7), used as a track for the finishing machine and to keep concrete from getting behind the longitudinal joint strip.

The special feature was the routing of the two mixers. This is shown by Fig. 8, which is also a daily performance record. Each mixer had a crew of eighteen men, whose duties were as follows:

2 Finishers	1 Operator on mixer
2 Operating longitudinal float	2 Dumping cement
2 Using long-handle floats	1 Moving hose ahead and setting expansion joints every 100 ft. apart.
1 Operating mechanical tamper	
3 Spreading concrete	
2 Cleaning up; moving steel angle irons ahead and placing longitudinal expansion joint proper	1 Dumping truck
	1 Foreman

The average crew on the whole job was 180 men.

In going over the daily progress records it was found that concrete had been poured continuously for 75 days without a shutdown except for Sundays and holidays, and on seventeen of these days two mixers were in operation. This kind of progress naturally entailed considerable study on the part of the contractor and resident engineer so that traffic might be continuously maintained. It was also found that the average number of batches of concrete per eight-hour day was 335, and that the maximum day's run had been 399 batches.

Organization Lessons—Besides the grading schedule referred to and the mixer routing, another feature which no doubt added to the efficiency was the rapid movement of equipment, not only on this particular job but from other jobs, by the use of heavy trailer equipment. This was so effective that for instance today two mixers would be running; tomorrow, one mixer would be gone and working on some other job; in two or three days the same mixer would be back on this job, not standing idle, but actually pouring concrete.

The organization of this contractor, the Griffith Company, Los Angeles, Calif., in general places the responsibility for the proper carrying out of the job on a superintendent who is in charge of several projects. Under this superintendent there is a superintendent of each specific project, and under the project superintendent a foreman in charge of each operation under way. The work of the company is so extensive that it is able to move its specialized crews, with foreman in charge, from one project to another, thus maintaining a crew of the same men, who become proficient in their work due to constantly doing the same thing. I noted one example of this in the case of the man operating the longitudinal float, who also attended to the proper finishing of expansion joints. On several expansion joints which this man finished he used no unnecessary motions, and the work was accomplished in each case by almost exactly the same number of movements.

The contract price for the work was $412,292. It was carried out by the County of Los Angeles Road Department.

Belgium's Cement Industry Flourishing

Belgium's cement industry is reported to have operated at or near capacity for the greater part of 1928, according to the U. S. Department of Commerce. In addition to a good domestic demand, exports were in excess of those of 1927. Shipments for the first eleven months of the year are reported as about 1,565,050 metric tons, compared with 1,471,141 tons in the corresponding period of 1927. Figures show a marked decrease in exports in two of Belgium's largest markets—Great Britain and France—and an appreciable increase in shipments to the two other principal markets—the Netherlands and the United States. The net results for the first eleven months of 1928 were an increase of 6½ per cent over the corresponding period of 1927. The Netherlands continues to occupy first place, but the United States, which occupied third place in 1927, advanced to second position, replacing Great Britain.

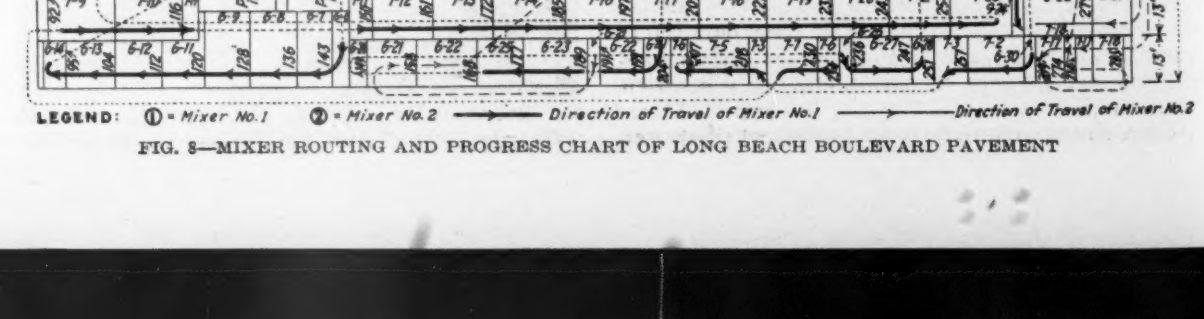


FIG. 8—MIXER ROUTING AND PROGRESS CHART OF LONG BEACH BOULEVARD PAVEMENT

Rigid-Frame Construction Applied to Structural Steel

Five-Girder Structure of 100-Ft. Span on 45 Deg. Skew Built by Westchester County Park Commission

By R. M. Hodges

Assistant Engineer, Westchester County Park Commission, Bronxville, N. Y.

A STEEL-GIRDER frame bridge, believed to be the pioneer of its kind has been completed by the Westchester County Park Commission as agent for the State of New York. The structure represents a logical extension to longer spans of the rigid-frame principle developed by A. G. Hayden, designing engineer of the Park Commission, and applied previously to more than a score of reinforced-concrete bridges now in service in various parts of Westchester County. Numerous articles have appeared in *Engineering News-Record* setting forth the principles of rigid-frame design as applied to reinforced-concrete construction and describing the structures built thereby. Some of these articles have appeared as follows, the last two being the most important and comprehensive: Jan. 11, 1923, p. 73; July 24, 1924, p. 150; July 2, 1925, p. 16; April 29, 1926, p. 686; and Nov. 1, 1927, p. 867.

The Mount Pleasant rigid steel frame bridge carries the Bronx Parkway extension over the right-of-way of the Harlem division of the New York Central Railroad about 2 miles north of the Valhalla railroad station in Westchester County, N. Y. It is one of a number of bridges, trestles and other improvements required for the extension of the Bronx River Parkway north from the Kensico dam to furnish a link in a direct route from New York City to the Bear Mountain bridge. The main features and principal details of the bridge are shown in Fig. 2. The design was made for Class B loading under the American Railway Engineering Association specifications for steel highway bridges. The allowable stresses used were based on the fundamental working stresses of 18,000 lb. per sq.in. net tension for steel and 800 lb. per sq.in. compression for concrete.

The transition from reinforced concrete to structural steel in rigid-frame design presents no serious difficulties, and the same economic and esthetic advantages apply in both cases. The use of structural steel simply makes it feasible to construct economically rigid-frame bridges of longer span. While no attempt will be made here to go into the details of rigid-frame design, it may be mentioned that under ordinary soil conditions rigid frames of one span are usually designed as hinged at the bases with corrections for restraint where necessary. (The Mount Pleasant bridge is a special case requiring special anchorage on account of its extreme skew.) Actual hinges will be provided for future rectangular structural steel rigid frames, but for reinforced-concrete frames it has been found satisfactory to approximate hinges by simply restricting the width of the footings to the minimum that will give allowable soil pressures under the applied vertical loads, with the resultant assumed located at the outer edge of the middle third. Attention is called to the fact that on account of the large ratio of rise to span (rarely less than 1:5) and the flexibility of the frame, temperature and rib-shortening stresses are almost negligible. Another important property of the rigid frame is its adaptability for designing purposes. By varying the amount of material in the knees, it is found that the shape of the middle or spanning portion may be varied to follow any reasonable combination of top and bottom curves without serious loss of economy, so far as the individual bridge is concerned. The designer, therefore, has a wide latitude in establishing proportions to meet any imposed requirements or existing conditions.

FIG. 1—MOUNT PLEASANT RIGID STEEL FRAME BRIDGE UNDER CONSTRUCTION

Structure of 100-ft. span carries Westchester County, N. Y., highway over New York Central Railroad tracks.

Since it is probable that the economic limiting span of solid-section concrete skewed-frame construction in comparison with structural steel is somewhat less than 100 ft., a structural steel bridge was planned for the Mount Pleasant location from the first. Comparative preliminary designs and estimates were made of a structural steel rigid-frame bridge and a simple-span through plate girder bridge. Neglecting the wing walls, which are largely independent of the type of structure used, the relative costs, including approach grading, were found to be approximately $115,000 for the rigid-frame and $140,000 for the through plate girder. These estimates were rough and probably below the actual costs for both types of bridges, but it was plainly indicated that the rigid-frame structure would be considerably the less expensive of the two.

Effects of Skew—Although it is general practice to neglect the torsional effects of skew in designing girder bridges, it was necessary in this case to consider carefully the effects of the 45 deg. skew on the structure as a whole and on the individual members.

It was found that the earth pressures against the cutoff walls could be taken care of without directly causing any torsion in the bridge by placing keys in the cutoff walls where they joined the footings. This is shown

in Fig. 3. The vertical applied loading is concentrated along the individual frame girder ribs, each of which, taken separately, is little affected by the skew. The frame girders are, of course, influenced by the skew in so far as they are restrained by other members of the structure. This restraining action between the main members of the bridge was kept to a practicable minimum in working out the connections and the details. For instance, the floor slab and cross-girder connections were considered sufficiently flexible with respect to the normal deflection of the main frame girders to be ignored as restraining factors. The earth cutoff walls, in which the vertical legs of the frame girders are embedded, could not be so disregarded. As the haunches of the frame girders tend to take their normal horizontal deflections under applied loading or temperature changes,

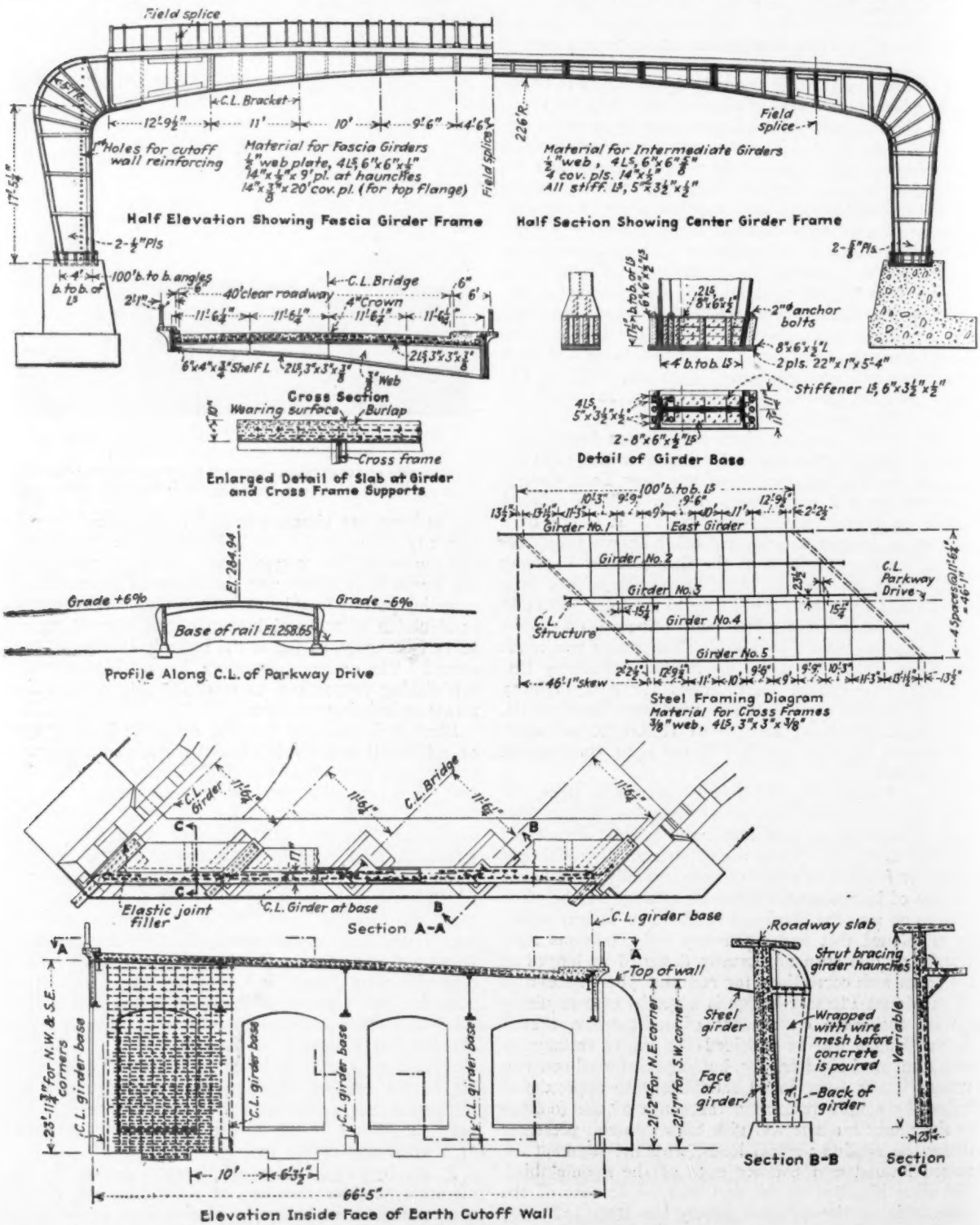


FIG. 2—DETAILS OF RIGID-FRAME STRUCTURAL STEEL BRIDGE

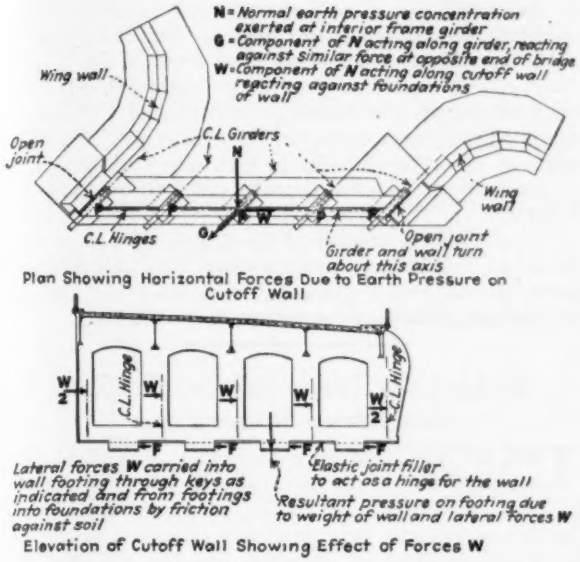

N = Normal earth pressure concentration exerted at interior frame girder
G = Component of N acting along girder, reacting against similar force at opposite end of bridge
W = Component of N acting along cutoff wall reacting against foundations
Wing wall
Open joint
C.L. Girders
C.L. Hinges
Wing wall
Open joint
Girder and wall turn about this axis
Plan Showing Horizontal Forces Due to Earth Pressure on Cutoff Wall
C.L. Hinge
C.L. Hinge
Lateral forces W carried into wall footing through keys as indicated and from footings into foundations by friction against soil
Elastic joint filler to act as a hinge for the wall
Resultant pressure on footing due to weight of wall and lateral forces W
Elevation of Cutoff Wall Showing Effect of Forces W

FIG. 3—RESOLUTION OF EARTH PRESSURE ON CUTOFF WALLS

the tops of the cutoff walls are obliged to move correspondingly. But since the walls are inflexible in all directions except in a direction perpendicular to their faces and can rotate only about their bottom edges, the girders are constrained to move in an oblique direction and are subjected to some torsion. The maximum horizontal deflections that could occur due to combined temperature and applied loading were found to amount to a maximum of only 0.4 in. Calculation showed that the girders possessed enough flexibility to twist through the corresponding small angle without developing a secondary stress greater than 1,500 lb. per sq.in. After conference with the New York Central Railroad designers to check the bridge details, it was decided as an additional measure of precaution to reduce further the horizontal deflections by fixing the girder frame bases to the extent shown in Fig. 2, instead of using hinged bases as originally intended.

The most troublesome effect of the skew was in the complexity of the details. The 45 deg. skew, in combination with the curved frame girders, and the entire absence of symmetry about any axis whatever of the bridge as a whole or any part of it resulted in variations in the dimensions and radii of each of the five main girder frames, so that no two of them are exactly alike.

Details—Particular attention is called to the details at the knees or haunches of the frame girders; to the absence of skew connections between structural steel members; to the great saving of material in the earth cutoff walls as compared with the usual type of bridge abutments; to the manner in which the finished grade over the bridge coincides with the structural contour of the bridge itself; to the way the intradosal curves follow the required underclearances; and to the graceful appearance of the span, obtained not at the cost of ornamental treatment and trimmings but simply as a by-product of an economical structural design.

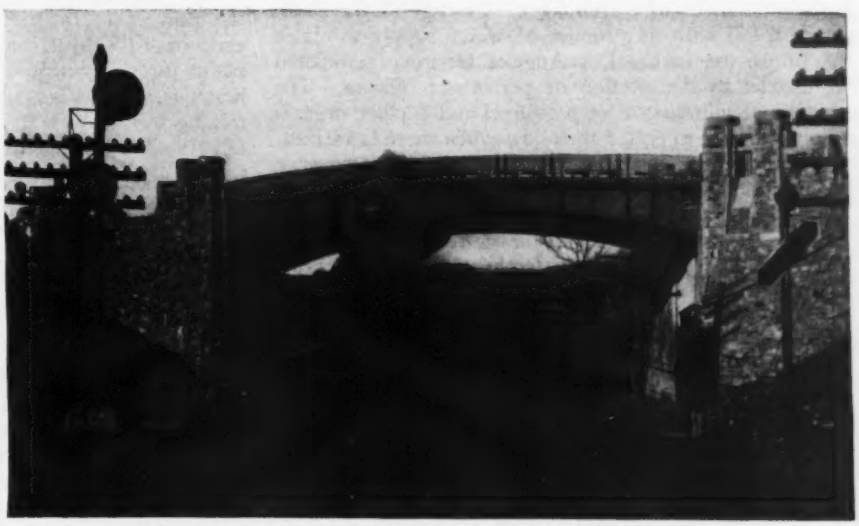


FIG. 5—THE MOUNT PLEASANT BRIDGE COMPLETED

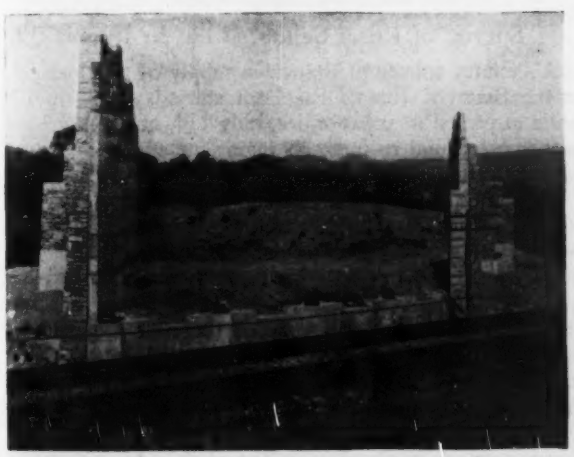


FIG. 4—FOUNDATIONS FOR THE STEEL FRAME RIBS
Note the absence of massive footings and abutments.

The total cost of the bridge, including contractor's profits but not engineering costs, was about $100,000. This figure does not include the cost of grading the approaches. The quantities of the principal items in the bridge are approximately as follows: Structural steel, girder frames, 135 tons; structural steel, floor beams, brackets, etc., 35 tons; reinforced concrete, floor, 200 cu.yd; reinforced concrete, cutoff walls, 250 cu.yd.; reinforced concrete, wing walls, 900 cu.yd.; reinforced concrete, footings, 250 cu.yd.

It should be noted that the quantities in the cutoff walls are increased about 40 per cent on account of the skew over that which would be required for a right-angled bridge and that a corresponding increase of 20 per cent occurs in the footings.

The design, plans and specifications were prepared under the supervision of A. G. Hayden, designing engineer, and J. Barnett, chief draftsman, the writer being in direct charge. H. T. Welty, engineer of structures, was in charge of checking the design for the railroad

company. Other persons directly responsible for the design details included M. Oberband, W. R. Frederick, H. L. Neve, L. Arup and J. A. Findlay for the Park Commission, and E. C. Grafton for the railroad company. C. L. Stoughton was the architect for the structure and all details of granite and stone masonry were prepared by him. Actual construction is being carried forward under the direction of W. F. Welsch, division engineer. The contractor for the wing walls and footings is the Immick Company, Inc., Meriden, Conn., and the J J. Farley Corporation, New York City, for the superstructure.

Water District to Direct Colorado River Aqueduct Project

Eleven Southern California Cities Organize Under State Act to Bring Water 300 Miles —Other Cities May Join

PERMANENT organization of the Metropolitan Water District of southern California, formed to direct the design and construction of a water-supply aqueduct from the Colorado River, has been effected to include a present nucleus of eleven cities. Passage of the Boulder dam bill with its promise of water supply available for future use in the Los Angeles territory stimulated the district to the election of permanent officers. The selection of administrative personnel and further organization steps are expected to follow when there is ratification of interstate compacts and more definite assurance that the Boulder Canyon dam project will be started soon.

Organization of the district was authorized by an enabling act passed by the 1927 session of the state legislature which provides for the co-operation of all cities which may elect to join such a district. The meeting of delegates from eighteen interested cities at which the organization of the present district was proposed was noted in *Engineering News-Record*, Sept. 1, 1927, p. 360.

CITIES GROUPED TO BACK COLORADO RIVER AQUEDUCT

City	Assessed Valuation	Percentage of District	Number of Directors	Number of Votes
Burbank	$23,393,795	1.03	1	2
Beverly Hills	59,412,840	2.61	1	6
Glendale	74,424,860	3.28	1	7
Los Angeles	1,863,559,210	82.02	10	40
Pasadena	124,126,620	5.46	1	12
Santa Monica	63,923,940	2.81	1	6
San Marino	14,607,065	0.643	1	1
San Bernardino	18,239,928	0.803	1	2
Colton	2,168,099	0.103	1	1
Anaheim	7,873,185	0.346	1	1
Santa Ana	30,336,065	0.892	1	2

The work already done on the 300-mile aqueduct project consists of surveys and studies (*Engineering News-Record*, May 31, 1928, p. 850) carried out principally with funds provided by a $2,000,000 bond issue passed by the city of Los Angeles. The results of this preliminary work will be turned over to the new water district, which will be vested with complete control over the Colorado River aqueduct.

The district is authorized to levy a tax not to exceed 5c. per $100 of assessed valuation for preliminary expenditures. With the present assessed valuation this would produce about $1,100,000 annually. Bonds for construction purposes may be issued at not less than par value following the approval of a bond issue by a majority vote of the qualified electors of the district.

The composition of the present district is shown in the accompanying table. Although the city of Los Angeles comprises 82 per cent of the assessed valuation in the districts, provision is made that no city is entitled to more than 50 per cent of the total votes of the district. Each city is entitled to one vote for each $10,000,000 of assessed valuation or major portion thereof. Representation on the board of directors is proportioned at a minimum of one representative to each city, with additional representatives for each $200,000,000 of assessed valuation.

The permanent officers of the district are: president, William T. Whitsett; vice-president, Franklin Thomas, professor of civil engineering, California Institute of Technology, Pasadena; secretary, S. H. Finley.

Sludge-Cake Production at Tri-Cities Activitated-Sludge Plant

THE OUTPUT of the sludge drier at the Tri-Cities activated-sludge sewage-works at Pasadena, Calif., has been increased 2½ to 3 times by the use of diatomaceous earth, according to a statement by W. C. Earle, city engineer of Pasadena, and this economy has been effected without increases in labor or fuel, which constitute practically the entire expense of the drying.

The diatomaceous earth is applied to the sludge at the rate of 11 lb. per 1,000 gal. in two mixing tanks each of 40,000-gal. capacity, which were added to the plant for this purpose. Ordinarily a period of three hours is allowed for agitation by compressed air in the mixing tank before the sludge goes to the filters. The filter sludge cake, with a moisture content of about 80 per cent, goes to the drier, which reduces the moisture to about 5 per cent. Since the diatomaceous earth has been used the drier output has been increased from 4 to 10 or 12 tons per 24 hours. Operation of the plant as a whole was described in *Engineering News-Record*, Sept. 27, 1928, p. 469.

Since the publication of that description the plant has contracted to sell the entire output of dried filter cake, f.o.b. the plant, at $25.25 per ton, which is expected to bring in a revenue of $75,000 a year. The use of diatomaceous earth makes it possible to convert into fertilizer all of the filtered sludge cake without any increase in drier capacity. Heretofore a part of the sludge cake always has been buried because the drier could not handle all of it. In 1927 the cost of burying excess sludge totaled about $37,000.

Survey of Rural School Wells in Illinois

A sanitary survey of the water supply of rural schools in the State of Illinois has been started. Out of 404 wells inspected in six counties, only 114, or about 28 per cent, were found to meet all requirements for approval, according to the *Illinois Health Messenger* of Feb. 15. Under the plan being followed, the bureau or county superintendent of schools chooses an inspector of wells and a state sanitary engineer spends a day or two with the inspector giving him instructions as to examining wells and sampling water from them. The samples taken are analyzed in the laboratory of the state Department of Health. Such wells as are approved by the local inspector are reinspected by a state sanitary engineer. If the wells are found satisfactory, an official state water seal is permanently attached to the pump. Thus far eleven counties have taken up the work. Inspections in Champaign County are nearly finished.

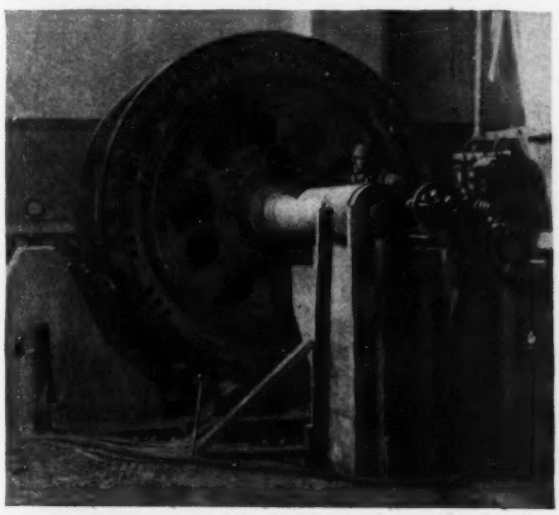
From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Sprung Generator Shaft Straightened by Improvised Field Methods

STRAIGHTENING a generator shaft 20 in. in diameter with improvised field equipment was the most serious problem encountered in reconditioning the two 17,500-kva. vertical hydro-electric generating units which remained after the San Francisquito No. 2 power plant of the Los Angeles Bureau of Power and Light had been swept away by the flood following the St. Francis dam failure. Data on methods used in this work were given in a paper by H. C. Gardett and A. R. Arledge before the Los Angeles Section, Am.Soc.C.E.

Unit No. 1, which was not in operation at the time of the flood, was practically uninjured mechanically and



RECONDITIONING GENERATOR SHAFT IN THE FIELD AFTER ST. FRANCIS DISASTER

after replacing minor parts, cleaning and drying it was put back into service when the rehabilitation of the plant was completed three months after the accident.

Unit No. 2 was running when engulfed in the 125-ft. flood of débris-laden water and continued to operate for three hours without lubrication until the valves at the top of the penstock were closed. After débris had been removed, it was found that although all accessories had been swept away, leaving only the bare hulk of the machine, the foundation had not been damaged and the stator and upper guide frame were intact, furnishing a starting point with which to begin reconstruction. The field coils were removed to Los Angeles for rebuilding and the stator coils, damaged beyond repair, were junked and replaced by a new set.

The most difficult problem was the sprung generator shaft, about 21 ft. long and ranging from 14 to 20 in. in diameter. This shaft carried a 72-ton laminated spider 8 ft. 6 in. in diameter shrunk in place. There was a 0.110-in. deflection in the 5-ft. section extending above the rotor and a 0.045-in. deflection in the 8-ft. lower end. As there was no machine tool in Los Angeles large enough to swing this size and weight, it was decided to recondition the piece at the site.

As a preliminary step the shaft was partly straightened by local spot heating with an acetylene heating flame on the concave side of the shaft.

Machine finishing was done by placing special cast-iron rings around the spider serving as tires to carry the weight of the rotor assembly. A concrete-supporting cradle was built, provided with two 8-in. roller bearings, made from 8-in. shafting, resting on pillow blocks having oil-pressure bearings, and the cast-iron tires were turned on these rollers. To revolve the mechanism, 5 kw. of power applied at one roller was required, and when 800 lb. of oil pressure was applied to the bearings the motor started the load easily.

Turning speed was 5 r.p.m. and the cutting speed of the specially designed machine tools was 20 ft. per minute. A special lapping tool was used to secure a proper bearing surface. As a result of these operations the shaft was finished to within 0.002 in. of perfect alignment.

Tractor Grading for Chicago Sewage-Works

TRACTOR-HAULED crawler dump wagons loaded by revolving power shovels and tractor-hauled elevating graders have been used on a grading contract of 500,000 cu.yd. for the sludge beds of the West Side sewage-disposal plant of the Sanitary District of Chicago at 39th St. and 52d Ave. For stripping the black earth overlying the clay, the contractor had three elevating graders loading large crawler dump wagons (see Fig. 1) and also 1½-yd. dump wagons hauled by mules. In this way he handled about 4,000 cu.yd. per day for ten days in September, 1928, when the ground conditions were good. For removing some old spoil dumps from the site, two 1-yd. power shovels were used, serving an assortment of trucks and tractors with various types of wagons. For excavating soft material, a 1-yd. dragline machine (and a 1-yd. gasoline shovel part of the time) loaded eight 7-yd. crawler dump wagons, which were hauled in pairs by 10-ton tractors (Fig. 2), excepting that only one wagon was hauled when wet weather and soft hauling conditions were encountered. All of the solid clay excavated was dumped in position to form a fill on which to build the future sludge beds. Under

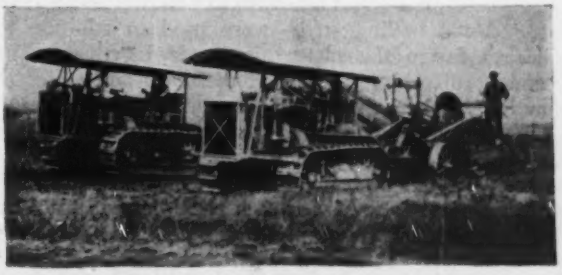


FIG. 1—TRACTORS HAUL ELEVATING GRADER AND CRAWLER DUMP WAGONS

FIG. 2—LOADING A TRAIN OF CRAWLER WAGONS

favorable conditions and with all equipment in service, there was an output of about 7,000 cu.yd. per day. The general contract for this part of the sewage works was let to the Warner Construction Company, Chicago, which sublet the grading to Conrad Ottenhoff & Company, Chicago, while the latter sublet the stripping to H. H. Enbody & Son, Aurora, Ill.

Pipe Braces Used to Hold Form Panels on Concrete Dam Construction

By Daniel McFarland
Storrie, Calif.

A SUCCESSFUL method of holding concrete form panels in perfect alignment, developed on the Exchequer dam and later used on the Hetch Hetchy dam, involves the use of iron pipe braces wedged against the panels from the inside, replacing the customary wood braces. Tie wires anchored to the preceding lift of concrete and tightened by wedges hold the panels against the pipe braces.

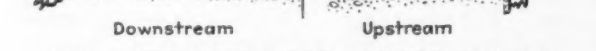


FIG. 1—METHOD OF HOLDING PANELS IN PLACE

Panel forms 8 ft. long, 4 ft. 6 in. high on the vertical upstream side and 5 ft. 3 in. high on the battered downstream side were built up of 1-in. sheeting on 2x6-in. studs spaced on 2-ft. centers with 2x6-in. top and bottom plate. Metal nailing strips were used in addition to spikes to fasten the plates and studs together. The sheeting projected ⅛ in. beyond the studs and plates to allow the panels to conform to the curvature of the dam.

The method of holding the panels in place is shown in Fig. 1. Each panel is spiked through the lower plate to the preceding tier of forms. Three ¾-in. iron pipes were used as the inside braces for each panel, held in place by wooden wedges at the upper end. To hold the forms against the pipe braces two rows of tie wires were used on the battered forms, and three rows of tie wires were used on the vertical form anchored to No. 4 wire anchors embedded in the previously poured concrete and wedged on the outside directly against the studding, no waling being used. The advantage of using the iron pipe for bracing is in the ease of removal. The wedges are knocked out and the iron pipe is removed just before the pour is completed. Trials show that the iron pipe proved to be a stiffer brace, formed less bond with the concrete than a wood brace, and in case the concrete had set so that removal was impossible, no harm resulted in leaving the pipes in place.

The panels were aligned to transit points by adjusting the wedges, resulting in an unusually straight wall.

From Job and Office

Hints That Cut Cost and Time

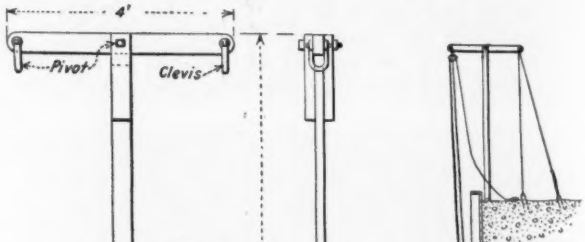


FIG. 2—GIN POLE USED TO RAISE THE PANELS

The panels on each face were kept at approximately the same height by inserting thin spacer strips between the forms for succeeding pours wherever the panels on one face were found to be creeping ahead of those on the other.

The gin pole used to raise the panels is shown in Fig. 2. The panels were moved after two succeeding lifts had been poured, being easily pried away from the concrete after the tie wires were clipped.

This scheme of panel form bracing was developed by E. R. Stokes, assistant superintendent, Utah Construction Company.

Use of a Submarine Cutting Torch at High Bridge Viaduct

ONE of the final operations incident to the reconstruction of High Bridge aqueduct in New York City (*Engineering News-Record*, Dec. 1, 1927, p. 864) was the removal of the cofferdam built around one of the piers on the east bank of the Harlem River. The cofferdam consisted of two rows of interlocking steel sheetpiling the watertightness of which was assured by pouring concrete into the joints. Space between the piling was filled with dredged material. The outer row of sheetpiling was withdrawn, but the inner row was cut

From Job and Office

For Contractor and Engineer

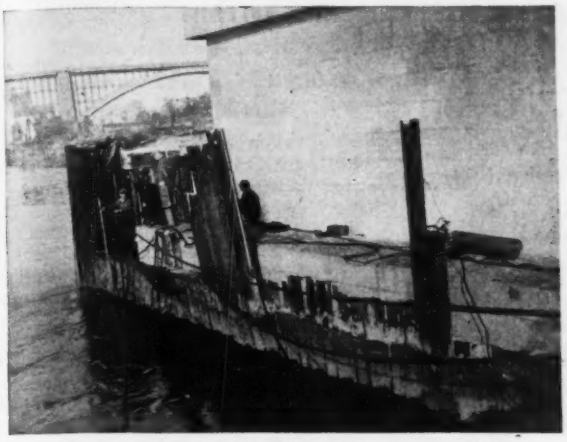


FIG. 1—CUTTING SHEETPILING UNDER WATER WITH A TORCH

Oxygen is supplied from cylinders shown on pier, while electric current is supplied by a generator on a barge.

off 2 ft. below low-water line and left to reinforce the pier. The procedure followed in the cutting operation is described herewith.

Both horizontal and vertical cuts were used, the latter being made to enable the piling to be removed in sections. For the horizontal cut and that part of the vertical cut under water, a submarine cutting torch was necessary, whereas for the vertical cuts above water an ordinary oxyacetylene torch was utilized. The webs of the piles, being only $\frac{3}{8}$ in. thick, were easy to cut, but at each interlock it was necessary to cut through nearly 4 in. of steel and concrete. This necessarily slowed up the work, but progress was made at the rate of about 14 lin.ft. of cutting per eight-hour day. There was in all about 100 lin.ft. of horizontal cutting.

The under-water cutting torch employed consisted essentially of a graphite electrode with two small holes for the passage of oxygen. The electrode was connected to one terminal of an electric generator and to an oxygen hose. The other terminal of the generator was connected to the work and an arc was struck between the electrode and the metal to be cut. A clamp connecting the cable to the sheetpiling is seen in Fig. 1 just to the left of the oxygen cylinders. The slight disturbance in the water at the left side of the picture shows the position of the cutting which at that time was being done about 8 ft. beneath the surface. When work was being done at moderate depth, oxygen was turned on and off at the regulator on the oxygen cylinder at signal from the diver. For work in deep water, a valve was placed at the torch handle. Fig. 2 shows the cutting torch with electrical cable and oxygen supply hose attached. The electrode is covered with rubber tape to protect the operator. Oxygen was supplied at 90-lb. pressure and as the heat of the arc raised the metal to the melting temperature it was quickly cut by the stream of oxygen.

The work was done for the P. T. Cox Contracting Company, Inc., New York City, general contractor, by the Under-Water Metal Cutting Corporation.

FIG. 2—DIVER HOLDING SUBMARINE CUTTING TORCH

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Use of Well Points

Sir—I have been greatly interested in the recent correspondence concerning the use of well points as an aid to excavation in wet ground. In relation to the same subject the following extract from a report on the construction of the Kilsby tunnel near Rugby, by Robert Stephenson, may perhaps interest some of your readers.

This tunnel, completed 1838, was carried through sands so heavily charged with water as to render them into quicksands, and considerable difficulty was experienced in advancing the tunnel. The difficulty was surmounted by sinking shafts along the line of proposed tunnel and installing steam pumps.

"As the pumping progressed," writes Stephenson, "the most careful measurements were taken of the level at which the water stood in the various shafts and boreholes; and I was soon much surprised to find how slightly the depression of the water level in the one shaft influenced that of the other, notwithstanding a free communication existed between them through the medium of the sand, which was coarse and open. It then occurred to me that the resistance which the water encountered in its passage through the sand to the pumps would be accurately measured by the angle or inclination which the surface of the water assumed toward the pumps and that it would be unnecessary to draw the whole of the water off from the quicksand but to persevere in pumping only in the precise level of the tunnel, allowing the surface of the water flowing through the sand to assume that inclination which was due to its resistance.

"The simple result, therefore, of all the pumping was merely to establish and maintain a channel of comparatively dry sand in the immediate line of the intended tunnel, leaving the water heaped up on each side by the resistance which the sand offered to its descent to that line on which the pumps and shafts were situated."

The above extract from the "Second Report to the Directors of the London, Westminster, and Metropolitan Water Company, 1841," p. 15. Library Inst. C. E. Tracts, Vol. 78, is taken from a lecture by Prof. Boyd Dawkins, *Proc.* Inst. C. E., Vol. 134, pp. 255-6.

Mellor, Derbyshire, England, Sept. 2, 1928.

W. H. CADWELL, Assoc. M. Inst. C. E.

News of the Week

Broken Wires Cause Rejection of Cables on Mount Hope Suspension Bridge

Order Means Dismantling of Suspended Span of Nearly Completed Structure —Some Breaks at Detroit—Both Structures Use a New Heat-Treated Wire—Cause of Breakage Undetermined

DISCOVERY of a number of breaks in the wires of the main cables of the nearly completed Mount Hope suspension bridge, near Bristol, R. I., on Feb. 22, and the subsequent discovery of many additional breaks have led to an order to take down the suspended span and to replace the cables with others of approved quality. Emergency repair work on the broken cable wires has been conducted under pressure during the past three weeks, and at the same time a considerable load of floor forms and reinforcing steel in place on the span has been removed. A few breaks of apparently similar kind are reported to have occurred in the wires of the Ambassador suspension bridge at Detroit, whose cables are of similar construction but which has not progressed as far toward completion as the Mount Hope bridge. Work was halted on the Detroit bridge March 1 pending full study of the situation.

Statement by Bridge Company

C. Philip Coleman, president, Mount Hope Bridge Company, on March 25 issued the following statement:

> On account of defects that have developed in the cables of the Mount Hope bridge, our engineers have condemned the cables and have ordered their prompt removal and replacement. This step, although it will mean an appreciable delay in the opening of the bridge, is indorsed and approved by the officers of the Mount Hope Bridge Company and by the contractors.
>
> Recognizing the trust reposed in them by the public, neither the officers and engineers of the company nor the contractors wish to take any chances by retaining in the structure an element regarding the safety of which any question has arisen.
>
> Our contractors, the McClintic-Marshall Company, have assured us that they will do all that is necessary to deliver to us the completed bridge in condition and form entirely satisfactory to us and our engineers. By reason of the fact that the necessary work of revision is difficult and unusual it is impossible to determine definitely the time that will be required. It is now estimated that there will be a delay of approximately six months, and if this is correct it means that the bridge can be opened about Nov. 15, 1929, instead of May 15 as anticipated.

A Private Toll Structure

The Mount Hope bridge is a private toll structure connecting Bristol and Portsmouth, R. I., and providing a link in a highway between Providence and Newport. It has a central span of 1,200 ft. and utilizes two 11-in. cables each with seven strands of 350 No. 6 heat-treated and galvanized wires. The heat-treated wire (also used at Detroit), while differing only slightly from ordinary cold-drawn wire in ultimate strength, has a yield point of about 85 per cent of the ultimate instead of the usual 65 per cent (190,000 lb. per sq.in. instead of 144,000 lb. per sq.in.). Cable spinning began on Sept. 10, 1928, and was completed Oct. 25, followed by the completion of the main and side span trusses and floor system on Jan. 15, 1929. At the time of the discovery of the breaks in the cable, forms and reinforcing rods were on the bridge deck in considerable quantities preparatory to pouring the concrete slabs and the cables were stressed to about 32,000 lb. per sq.in. as compared with their ultimate working stress of 80,000 lb. per sq.in. with the bridge completed.

The original specifications for the Mount Hope bridge contemplated the use of cold-drawn wire such as has been used on suspension bridges heretofore. However, the specifications were changed to admit a new heat-treated cable wire which had shown excellent results under severe test conditions and had been adopted for the Detroit suspension bridge, and later this wire was approved for use on the Mount Hope bridge.

Changes in Specifications

In changing the specifications as originally drawn, the ultimate strength was raised from 215,000 to 220,000 lb. per sq.in. The specified elongation of 4 per cent in 10 in. remained unchanged. The elastic limit, however, was raised to 190,000 lb. per sq.in., and the bend test, which had originally provided for bending the wire around a rod of 1-in. diameter, was changed to the requirement that it be bent around four diameters of the wire without damage, after tests had shown that the wire could be bent satisfactorily around one diameter. The minimum reduction in area was placed at 30 per cent. The wire passed all of these specified requirements to the satisfaction of the engineers and the contractors. Modjeski & Chase carried out the wire inspection for the engineers in conjunction with

(*Continued on p. 520*)

80,000-Hp. Turbines Ordered for Russian Government

An order for four hydraulic turbines and generators, said to be the largest ever constructed, has been placed with the Newport News Shipbuilding & Dry Dock Company and the International General Electric Company by the Soviet government of Russia. The turbines are for the hydro-electric plant now under construction on the Dnieper River.

The four hydraulic turbines are to be of 80,000 hp. each, direct connected to four vertical electric generators of 77,500 kva. each. The plant eventually will contain ten such units.

Hugh L. Cooper, New York, is consulting engineer on the project. A. V. Winter is chief engineer.

United States Purchases Dismal Swamp Canal

The Secretary of War has approved the recommendation of Major Gen. Edgar Jadwin, Chief of Engineers, for the purchase of the Lake Drummond Canal for $499,000, under the provisions of the rivers and harbors act of March 3, 1925, authorizing the Secretary of War to purchase this canal as a part of the inland waterway from Norfolk, Va., to Beaufort, N. C.

The Lake Drummond Canal, commonly known as the Dismal Swamp Canal, is about 22½ miles long, extending from Deep Creek, an arm of the Elizabeth River in Norfolk County, Va., to the Pasquotank River in Camden, N. C.

Bids to Be Opened on Cushman Project No. 2

Bids will be opened about April 8 for construction on the city of Tacoma's Cushman project No. 2, including a constant angle arch dam 240 ft. high, 450 ft. in length on the crest and 60 ft. long at the bottom, which will contain about 30,000 cu.yd. of concrete, and a concrete-lined tunnel 13,000 ft. long, leading from the dam to the bluff above the power house site. Purchase of equipment also will be included. The work will cost approximately $3,000,000 and forms the major portion of the proposed expenditure of $4,200,000 for the entire unit. J. L. Stannard, chief engineer, is in charge of the work.

65-Mile Railway Proposed for Texas

The Kansas City, Mexico & Orient Railroad of Texas, a subsidiary of the Atchison, Topeka & Santa Fe Railway, has applied to the Interstate Commerce Commission for authority to construct an extension of its line from San Angelo to Sonora, Tex., a distance of 65 miles.

Alabama's Worst Flood Wrecks Towns, Railroads and Highways

Sudden Deluge Following Long Wet Season Wreaks Terrific Damage—Elba, Geneva and Brewton Hit Hardest—L.&N., A.C.L. and Central Georgia Railroads Suffer—1,350 Miles of State Highways Affected

By H. W. Richardson
Assistant Editor, Engineering News-Record

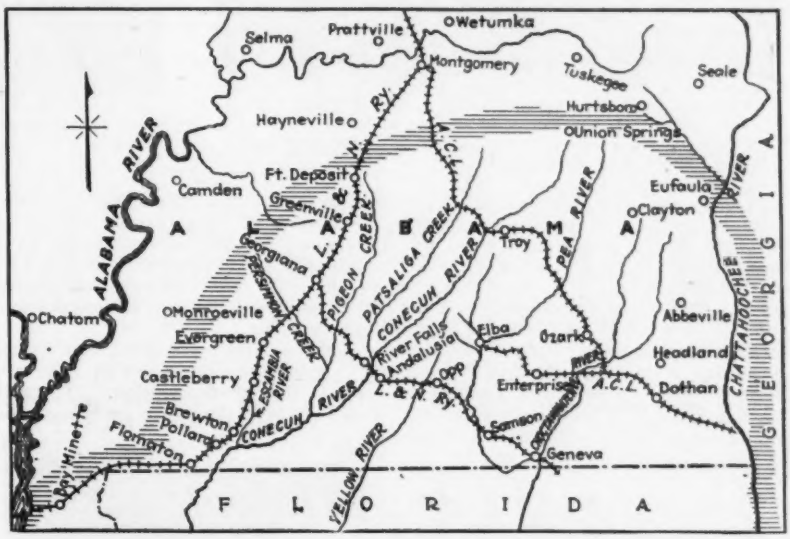
SWEEPING before a deluge of rainfall ranging in intensity from 13 to 27 in. falling in 24 hours, following a prolonged wet season, floods virtually wiped out one town, badly damaged a score more, wrecked miles of railroads and highways and tore out innumerable bridges and culverts in southern Alabama March 14 and 15. Elba, with a population of 1,600, situated at the junction of Pea River and Whitewater Creek, suffered the worst of all, with not a dwelling or business block left intact. Geneva and Brewton were inundated to a depth of 12 to 15 ft., but escaped the terrific swift currents that caused so much damage at Elba. Flomaton, Pollard, Castleberry, River Falls and Garland suffered heavily. State highways totaling 1,350 miles were affected, in many places being completely washed away. There is no possible way to estimate the damage done to secondary and county highways.

Railroads Hard Hit

Of the railroads the Louisville & Nashville suffered the most damage, and the Atlantic Coast Line and Central of Georgia were also hard hit. Bridges, fills and yards of the L.&N. main line between Georgiana and Flomaton were wiped out in many places, the line being out of service nine days. The L.&N.'s lines near Mobile; between Flomaton and Pensacola, Fla.; between Georgiana and Geneva, and between Pensacola and River Junction, Fla., were badly damaged, some of the lines still being out of service. On the Atlantic Coast Line, the main line between Montgomery and Dothan was washed out in many places, being out of service six days, while the branch from Newton to Elba was so badly washed out that it is still out of service. The Central of Georgia suffered heavily on many lines, especially in the vicinity of Geneva. In the central part of the state the Western of Alabama was damaged.

No official figures of rainfall during the deluge are available for many sections. Officially, Ozark reported 13.4 in. falling between 8 a.m. March 14 and 8 a.m. March 15. Mobile reported 8.92 in. and Macon, Ga., 4.64 in. during the same period. However, fairly reliable unofficial figures place the amount falling in this period at Elba and vicinity at 27 in., most of which fell from 8 a.m. to 5 p.m. on March 14. The damage done seems to justify these figures. At Flomaton and Brewton, the fall is estimated at 21 in. for March 14.

Alabama, in common with all the Southeastern states, had been subject to almost continuous rainfall since the first of February. In the southern part of the state especially the creeks and rivers were bank full and the ground was fully saturated. With the natural channels already full, waters from the unprecedented rainfall of March 14 swept in torrents down ordinarily dry ravines and across fields and forced every stream out of its banks.



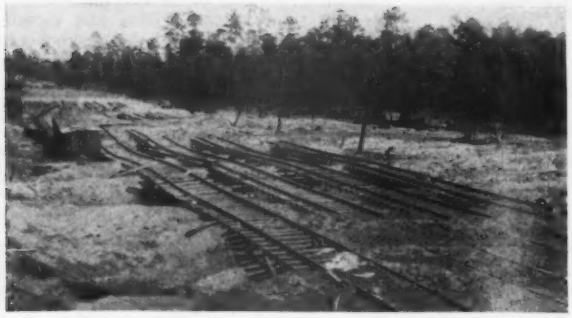
FLOOD AREA OF SOUTHERN ALABAMA
Approximate limits of region subject to heavy rainfall shown shaded.

Extent of Damage

Highways—In the flood area from Montgomery to the Gulf are approximately 1,350 miles of state highways. Woolsey Finnell, director of the state highway commission, and his staff estimates that it will cost $1,000 per mile, or $1,350,000, to restore the roads to normal, not counting the loss of surfacing on miles of gravel and sand-clay roads. The principal damage to the state highways was in loss of fills, which are mostly sand, especially around the ends of bridge abutments. The bridge openings, designed for the previous high water, estimated about half of the present flood, proved inadequate in almost every location to handle the rush of water. Hardly an approach fill was left intact. Director Finnell's reconstruction program calls for more than 5,000 lin.ft. of additional bridge openings. Short retaining walls will be added to the existing flaring abutment wing walls, which seemed to aggravate the washing out behind abutments.

A remarkable feature of the highway damage is the way the bridges withstood the floodwaters. But three 16-ft. spans of recent construction were

ATLANTIC COAST LINE RAILROAD AND U. S. HIGHWAY 231 NEAR OZARK, ALA.
Note sections of concrete pavement undermined and tossed about yet not broken.



WASHOUT IN THE LOUISVILLE & NASHVILLE YARD AT FLOMATON, ALA.
Water running across the yard carried away the light filling material under the tracks throughout the yard.

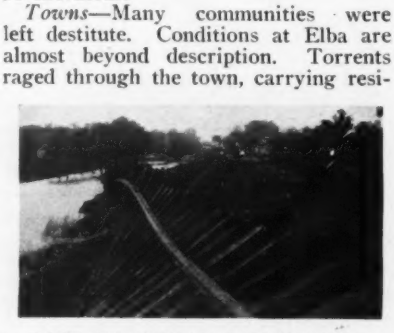
A WASHED OUT FILL ON THE CENTRAL OF GEORGIA RAILROAD NEAR OZARK, ALA.
This part of line located near top of ridge with drainage area of this opening less than 30 acres.

lost, and very few older spans in the state highway system. For the most part the design consists of wood pile bents, steel stringers and laminated wood or concrete decks. This type structure stood regardless of overtopping and the rush of débris of all kinds. County bridges, most of which were old wooden structures, were wiped out by the score. Besides the complete loss of sections of fills, hundreds of holes were washed out in the roads which will require weeks to fill. Another serious loss to the highway system is the washing off of much gravel and sand-clay surfacing. This, while not rendering the highways impassable, will show up as costly maintenance.

Practically all the state roads were opened within a week's time, many in a few days, by building temporary trestles across washed-out fills or by providing detours. Aid is being sought from the government in rebuilding the federal aid projects. Representatives of the U. S. Bureau of Public Roads have checked with the state highway department on the extent of damage done.

Railroads—The railroad systems in the flood area suffered much more damage than did the highways. Yards and tracks were completely washed away, fills settled and many bridges were completely lost. Emergency measures were resorted to in restoring service and a vast amount of work will be required to bring the roadbeds back to normal. Where service has been restored normal operation is impossible, work trains and reconstruction interfering with train operations, already slowed down by temporary tracks and structures. It is impossible to estimate the damage done to the railroads. Outside of reconstruction costs, the loss of revenue will be enormous.

Towns—Many communities were left destitute. Conditions at Elba are almost beyond description. Torrents raged through the town, carrying resi-



LOUISVILLE & NASHVILLE RAILROAD NEAR GENEVA, ALA.

dences for blocks, undermining and collapsing brick buildings, gouging huge holes in the streets and yards and filling them with buildings, autos and other débris. Many stores were swept clean of contents, others filled with mud. The town looks more as if a tornado had struck it than a flood. Sides are torn off of brick buildings, frame buildings and houses are twisted and torn, piled up in places, one upon another, swept bare in one block and jammed together in another section. Huge trees were torn up and tossed in every direction. Poles, wire, fences, shacks and sidewalk slabs are piled up and strewn about in every direction.

Flomaton was hit by a rush of water, though not so destructive as that at Elba. Geneva and Brewton suffered mostly from inundation, though many buildings, mostly shacks, in both towns were destroyed. The other communities suffered in varying degrees from both inundation and destructive rushes of water.

Sanitary and General Conditions—Quick mobilization of the National Guard and the Red Cross did much to save life, aid refugees and maintain sanitary conditions. Flomaton, Brewton, Elba and Geneva were put under military control at once. Preventive measures have apparently warded off typhoid fever and other diseases. In most of the communities the water supply was obtained from artesian wells, which offered little chance for pollution. At Flomaton the water is obtained from shallow wells, and little was done to protect the supply until the arrival of the National Guard unit. Medical authorities and the guard units supervised the removal and burning of carcasses. More than 1,200 carcasses were taken out of Elba. Airplanes have played an important part in the distribution of food and medical supplies. The Red Cross quickly established a code whereby those on the ground could signal their needs to aviators by blocking out letters with white muslin. Gov. Bibb Graves took active command of the relief measures.

Despite the enormous property dam-

LOUISVILLE & NASHVILLE RAILROAD TRACKS AT FLOMATON, ALA.
Trestle carrying one track built before waters had subsided, being built where once stood a 10-ft. fill.

U. S. HIGHWAY 231 ACROSS CHOCTAWHATCHEE RIVER NEAR OZARK, ALA.
The 10-ft. bridge approach fill was washed out, leaving the bridge at the right intact.

TYPICAL OF THE HOLES SCOURED OUT AT ELBA, ALA.

REAR OF THE HOTEL AT ELBA, ALA.

age, very little loss of life occurred, the known dead totaling but eleven. Tales of hardship and thrilling rescues are numerous. Several passenger trains were caught by the waters. Railroad construction crews were busy before the waters subsided, and telephone wires were strung along tree tops by linemen working in boats.

Georgia, central Alabama and western Florida were flooded at the same time. The Alabama River is still dangerously near flood stage, with many persons,

BUILDING UNDERMINED AT ELBA

mostly negroes, marooned in the lowlands near Selma. Caryville, Fla., was inundated by the waters coming down from the north, and other Florida communities were damaged.

Farm lands were badly washed. In many districts fully half of the cultivated acreage was rendered useless for planting this year.

Flood Damage in Florida

The Louisville & Nashville Railway suffered heavily between Pensacola and River Junction, Fla. It will be necessary for it to build 1,600 ft. of trestle at Caryville. The line will be out of service two weeks. Both the highway and the railroad bridge across the Choctawhatchee are undamaged but the fills were washed out on each side of both bridges. The state highway at Caryville lost 1,000 ft. of fill and 2 miles of clay base and treated surface. Part of the fill is being replaced with 1,600 ft. of new trestle.

WRECKAGE AT BREWTON, ALA.

Floods in Tennessee

Serious damage from floods in east Tennessee and Kentucky is reported to be confined to the area from Pineville, Ky., to Harriman, Tenn., a rugged and mountainous region consisting largely of cut-off timber lands with small swift streams in narrow valleys which reduce to gorges in many places. As in Georgia and Alabama, local cloudbursts following long-continued wet weather caused a sudden and great rise in the streams. All previous flood heights were exceeded. Press reports of the extent of the damage are, however, believed to be exaggerated, as the region is sparsely settled. Extent of the damage to the railroads and roads is not known.

Dividing Wall of Water Basin Fails at Baltimore

On March 22 the dividing wall between two settling basins at the older of the two water-purification plants of Baltimore failed under unbalanced pressure just as workmen were about to enter the empty basin. The basins had been out of use since last September, but one of the two has had a considerable depth of water in it for some time past, while the other was left empty in order that repairs might be made.

The wall was about 15 ft. high, and had a T-section with tapered vertical portion about 8 in. thick at the top and 15 in. at the bottom, while the flat base extended out on either side 5 or 6 ft. Under the base a shallow cutoff or dowel wall extended some 18 in. down into the soil. The wall moved out sideward in integral construction sections, without breaking, being slightly displaced vertically and tipped somewhat in the movement. The appearance of the wreckage suggests that water seeping under the wall from the full basin developed sufficient upward pressure under the unloaded side of the base to lift it and allow the water pressure to push it out of position. The basin floor was a concrete slab in sections, apparently not waterproofed. No drains were provided under the wall. In ordinary operation the wall was subjected to unbalanced pressure for only short periods, when one of the two basins was emptied for cleaning.

The plant was built about fourteen years ago, under Ezra B. Whitman as water engineer of Baltimore, with James W. Armstrong as engineer in direct charge. It was completed in September, 1915.

An investigation of the accident is being made by Prof. John H. Gregory, of Johns Hopkins University, for the city authorities.

Legalize Higher Steel Stresses in Philadelphia Code

On March 15 the Pennsylvania Legislature adopted a bill fixing 18,000 lb. per sq.in. as the permissible stress in steel framework of buildings in Philadelphia. This provision was made a matter of special legislation. The stress increase had been included in a draft of a general code which is now before the legislature for adoption; but as there was every prospect that action on the new code would be long delayed, and as the legislature may soon adjourn and will not be in session again until 1931, the 18,000-lb. proviso was made the subject of a special bill, which was passed by the legislature and approved by Governor Fisher.

Making Preparations for Survey of All-American Canal

With the return to Washington of Dr. Elwood Mead from Denver the Bureau of Reclamation began the necessary preparations looking to the survey of the All-American Canal. While the contract which was drawn up at Denver has not been ratified by the Imperial Valley Irrigation District at the time of this writing, Dr. Mead is certain that it will be approved and no time is being lost in getting ready for the work. Under this contract half of the cost will be paid by the irrigation district. The Bureau of Reclamation will pay the other half.

Mount Hope Suspension Bridge

(*Continued from p.* 516)

their inspection of the wire for the Detroit bridge.

During the handling and spinning of the cables, it is said, nothing unusual threatened or developed and it was not until January, with the main span steel erection well under way, that an inspector found three broken wires in the Bristol anchorage near the tangent point where the wires leave the strand shoe. This was not thought serious until on Feb. 22 many additional broken wires were discovered in one of the strands in the Bristol anchorage. This led to an order to cease work on the bridge and to immediate preparation for repairing the structure in the interests of safety.

A careful examination of the cables made by inserting a hook into the splayed part of the cable and pulling out each individual wire revealed between 300 and 400 breaks, each affecting two cable wires. The largest number of breaks occurred in two strands, one in each cable and localized at opposite ends of the cables. There were comparatively few breaks in the other strands. In the most seriously affected strand about 250 of the total of 350 wires were broken. Constant examinations of the cables have been maintained to date in order to detect any additional breaks as they occur.

An important factor in connection with a majority of the breaks is that they are localized very near the tangent point on the shoe. The spinning operations were unusual in only one particular, that before looping the wires around the shoe they were preformed to the strand-shoe diameter of 19 in. by bending them around a sheave 9½ in. in diameter fastened to the top of the shoe.

In repairing the breaks the broken loops were removed and replaced by new loops made of cold-drawn wire about 20 ft. long threaded at each end for splicing. The structure is thus temporarily safe and the constant inspection of the cables is being continued.

In carrying out the order to remove and replace the cables it will be necessary to take down the main span floor steel, the stiffening trusses and the suspender cables, and then remove the cables, after which new cables must be spun and the suspended steelwork re-erected.

Work on Detroit Bridge Halted

A few wire breakages have also occurred on the Ambassador bridge at Detroit, but these were not considered significant until the breaks were disclosed at Mount Hope. All work on the Detroit bridge was halted March 1, at which time about 25 per cent of the floorbeams had been attached to the suspenders on the main span and stiffening truss erection had just been begun.

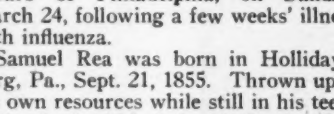
The Detroit bridge is a considerably larger structure than the bridge at Mount Hope, having a central span of 1,850 ft. carried by two cables each of 37 strands of 206 No. 6 heat-treated and galvanized wires shipped from the same plant and presumably from the same stock as those at Mount Hope. At the present stage of construction the Detroit cables are stressed to only 10,000 lb. per sq.in., as compared with their ultimate working stress of 84,000 lb. per sq.in. Work on the Detroit structure is nearly a year ahead of schedule, hence a delay at the present time should not postpone opening of the bridge.

The Mount Hope bridge is being built by the Mount Hope Bridge Company, for which Robinson & Steinman, New York City, are consulting engineers. The Detroit bridge is being built by the Detroit-International Bridge Company, for which Modjeski & Chase, also of New York City, are acting as consultants. The McClintic-Marshall Company, Pittsburgh, is the engineer and contractor on the Detroit bridge and is the general contractor on the Mount Hope bridge. The cables on both structures were erected by the Keystone State Corporation, Philadelphia; the wire was manufactured by the American Cable Company, New York. For the McClintic-Marshall Company, L. S. Moisseiff, New York City, and Monsarrat & Pratley, Montreal, are consulting engineers.

Samuel Rea, Former President of Pennsylvania R.R., Dies

Samuel Rea, former president of the Pennsylvania Railroad system, who retired from active service in September, 1925, died at his home in Gladwyne, a suburb of Philadelphia, on Sunday, March 24, following a few weeks' illness with influenza.

Samuel Rea was born in Hollidaysburg, Pa., Sept. 21, 1855. Thrown upon his own resources while still in his teens by the death of his father, he began work as a chainman and rodman on the location of the Morrison's Cove branch of the Pennsylvania in 1871 to learn engineering by the apprentice system so generally in effect in those days. The panic of 1873 put a stop to this work and forced him to seek employment with the Hollidaysburg Iron & Nail Company. In the spring of 1875 he reentered the service of the Pennsylvania to become an assistant engineer on the Point bridge over the Monongahela River at Pittsburgh. When that work was completed he was appointed an assistant engineer on the locating surveys for the Pittsburgh & Lake Erie Railroad, where he remained until the completion of the road, becoming its first ticket agent at Pittsburgh. In 1879 Mr. Rea again returned to the Pennsylvania system on the extension of the Pittsburgh, Virginia & Charleston Railway, south from Monongahela City, later becoming engineer in charge of surveys in Westmoreland County and on the rebuilding of the Western Pennsylvania Railroad as a low-grade freight line. This work was under the direction of J. M. DuBarry, then assistant to the president, and after Mr. DuBarry went to Philadelphia as vice-president, Mr. Rea, in 1883, was transferred there as his assistant with the title of principal assistant engineer and subsequently assistant to the second vice-president.



SAMUEL REA

In 1889 Mr. Rea resigned to go to Baltimore as vice-president of the Maryland Central Railway Company and chief engineer of the Baltimore Belt Railroad, which he located and put under construction for the Baltimore & Ohio Railroad Company. In 1891, on account of ill health, he resigned and left Baltimore. After a year's rest, he returned to the Pennsylvania as assistant to the president, leaving immediately for London to make a study of the underground railway system of that city. Some years previous to this time he had begun to take a keen interest in the possibility of providing a terminal for the Pennsylvania Railroad on Manhattan Island and had become one of the incorporators of the North River Bridge Company in 1890. His studies in London were in furtherance of this project and from that time forward much of his time was devoted to preliminary studies and subsequently to definite plans for the tunnels under the Hudson and East rivers and across Manhattan Island to connect the Pennsylvania and Long Island railroad systems, and thus give access to a new terminal in Manhattan Island, and eventually to connect up with the New Haven railroad by means of the New York Connecting Railroad and the bridge over Hell Gate.

Upon the resignation of James McCrea as president of the Pennsylvania system in 1912, Mr. Rea was appointed president to succeed him, a position which he held until his retirement for age in 1925.

Many honors were conferred upon Mr. Rea during the latter years of his life. Chief among them were honorary membership in the American Society of Civil Engineers in 1921 and in the Institution of Civil Engineers (Great Britain) in 1929.

Maryland Sets Qualification for County Roads Engineer

The Maryland General Assembly, now in session at Annapolis, has passed a bill which provides that the roads engineer of Allegany County must have a degree as civil engineer and have ten years' practical experience.

U.S. Engineers Urge More Reclamation at Denver Conference

Progress on Current Work Reported and Requests for Additional Developments Discussed

A BIENNIAL conference of engineers of the U. S. Bureau of Reclamation at Denver during the week of March 11, which discussed reports on progress and proposed work for the coming year, gave opportunity for advocates of additional reclamation in different states to present the claims of their projects. Farmers on the Milk River project in Montana asked for postponement of annual payments. Representatives of the Imperial Valley brought up the question of the All-American Canal included in the Boulder dam act and indicated that the valley people would pay for it.

Construction of a power plant on the Gunnison River was asked for by residents on the Uncompahgre project in Colorado. An agent of the Missouri, Kansas & Texas Railroad proposed an irrigation project in western Oklahoma. Pleas were made for government irrigation development in the San Luis Valley in southern Colorado. Utah interests sought assurance that the proposed ten-year reclamation development begun by the Echo reservoir will be carried on consistently.

A co-operative investigation of Wyoming projects is to be carried out by the bureau on a basis of sharing the cost with the state, $50,000 being available for the purpose. The proposed work includes further drilling at the site of the dam for the proposed Casper-Alcova project and at other structure sites topographic and canal surveys and land studies.

Review of Current Work

A general review of current work by R. F. Walter, chief engineer of the bureau, was prominent among the papers read at the conference. He pointed out that during the past two years no money has been appropriated for new projects and that during the next eight years the annual reclamation-fund receipts will be fully used up in completing the ten-year program. Four dams were completed during the two years (American Falls, McKay, Guernsey, Stone Gorge), at a total cost of $13,068,000, against estimates of $14,100,000. At present three dams are under construction (Gibson, 82 per cent completed; Draybee, Echo) at a cost of $12,000,000. Three further dams are to be advertised this year; they are Deadwood, 50 miles north of Boise, a 160-ft. concrete arch structure 600 ft. long, to cost $1,200,000; Avalon, on the Secos River in New Mexico, about 8,500 ft. of embankment of 65-ft. maximum height, to cost $1,412,000; and Cle Elum, at the outlet of Lake Cle Elum, Wash., a 130-ft. embankment 750 ft. long, to cost $2,500,000.

Geological Survey Celebrates Its 50th Anniversary

Members of the Geological Survey, their former associates and their friends to the number of more than 600 assembled in Washington on March 21 to celebrate the 50th anniversary of the establishment of the bureau. They were received at the White House by President and Mrs. Hoover. In the afternoon they listened to the new Secretary of the Interior and other prominent speakers and at night were entertained at a banquet which was followed by skits of the Gridiron type.

Dr. George Otis Smith, who has served as director of the Survey since 1907, in his remarks at the afternoon session, which was held at the Smithsonian Institution, said:

"Not only has the Geological Survey been the mother of men but as the scientific and engineering work has expanded, it has become the mother of bureaus. The work now being done by the Bureau of Reclamation, the Bureau of Mines, the Bureau of American Ethnology, the Forest Service and the Geophysical Laboratory of the Carnegie Institute had its inception in the Geological Survey. We find with pride that three out of four directors of the Reclamation Service and four of five directors of the Bureau of Mines have been graduates of our Survey. During its 50 years of useful engineering the Survey has had its allowance gradually increased from $100,000 for the fiscal year 1880 to more than $2,000,000 for the fiscal year 1930. The expenditures for the half-century have been $75,000,000."

Other addresses were made by Secretary Wilbur; Arthur Day, director of the Geophysical Laboratory; Henry Fairfield Osborn, and Arthur Morgan.

At the dinner the speakers were Wallace Atwood, E. W. Berry and Representative Corey, of Pennsylvania.

State-Owned Cement Plant Is Proposed for Oklahoma

An appropriation of $1,000,000 for establishment of a state-owned cement plant and the creation of a board of control of three members to handle the business of the plant is provided by a bill introduced in the Oklahoma House of Representatives. One member of the board would be appointed by the State Senate, one by the House of Representatives, and one by the Governor with the consent of the Senate. The members would hold office for four years and would draw pay at the rate of $10 a day while actually engaged in duties in connection with handling affairs of the plant. The board would have authority to employ a superintendent at a salary of not more than $10,000 a year. The cement required by the state in its public roads and buildings would be supplied by the state plant at actual cost of production, and convict labor would be provided at a wage of 50c. daily.

Pioneer Association Discusses Sewerage and Sewage-Works

Many Papers and Large Attendance at Fourteenth Meeting of New Jersey Sewage Works Association

LARGE attendance and a variety of practical and theoretical papers were features of the fourteenth annual meeting of the New Jersey Sewage Works Association, held at Trenton, N. J., March 22 and 23. Of some 150 in attendance, many were from outside the state, some of these coming by invitation to present papers. Four sessions were held.

How improper operation of sewage-works may increase the mosquito nuisance by ponding and also by stopping up drainage channels was set forth by John P. Peterson, superintendent of the Bergen County Mosquito Extermination Commission, Hackensack, N. J. Sewage volumes running up to four or five times and in extreme cases to ten times the normal dry weather flow at Westfield, N. J., was attributed by Alexander Blair, formerly town engineer, to the practice of building contractors of draining cellar excavations to the sewers. Although cast-iron pipe has been used for sewers in Westfield for a dozen years or so, these abnormal sewage flows have continued. This led Mr. Blair to conclude that the high flows could not be due to leakage through joints.

The way in which efficient sewage-works operators have been obtained in North Carolina and their efficiency increased was described by G. M. Ridenour, formerly with the North Carolina Department of Health, now in charge of water and sewage for the Division of Institutions and Agencies of New Jersey. The colleges of the state have been drawn upon for operators and the engineering division of the State Department of Health has taken a hand in introducing new operators to their work. F. H. Waring, chief engineer, Ohio State Department of Health, Columbus, described the uniform report sheets for sewage-works which have been prepared and are gradually being adopted in that state.

Sewage-Works Operation Described

A number of papers dealt with sewage-works operation. Of these, two related to Imhoff tanks, at New Castle, Pa., and Trenton, N. J., the former being taken up by Wellington Donaldson, of Fuller & McClintock, New York, and the latter by P. N. Daniels, city sanitary engineer of Trenton. A comparison of the efficiency of the one-story settling tanks of Syracuse, N. Y., in actual operation with the expected efficiency as predicted by studies at the testing station was presented by Glenn D. Holmes, chief engineer, Syracuse Intercepting Sewer Board. Not only were the working results obtained in line with those predicted but they more

than justified the expense of the testing station.

Good results obtained from iron chloride as an aid to sludge digestion were reported by Dr. Willem Rudolfs, New Jersey Sewage Experiment Station, New Brunswick. Dr. Rudolfs also submitted a report for a committee on cooperative studies of methods of determining biological oxygen demand. Correspondence with various collaborators as well as the discussion following the report led Dr. Rudolfs to conclude that further effort toward standardization was necessary before anything like comparable results from various sewage-works could be expected. A brief statement as to development in odor control of sewage-works during 1928 was made by A. L. Fales, of Metcalf & Eddy, Boston, who spoke favorably of control by chlorine. Operating experiences with automatic sewage pumps at Morristown, N. J., were outlined by F. A. Hoffman, superintendent, water and sewage-works, of that city. The relation between enzymes and sewage-sludge digestion was taken up by Noel Chamberlain, chemist, New Jersey Sewage Experiment Station, New Brunswick.

An activated-sludge plant with mechanical means of aeration now being built for Barrington, N. J., was described by W. D'W. Vosbury, consulting engineer, Camden, N. J. The effluent will be passed through rapid sand filters before discharge into a stream having a very small flow.

Edward D. Shissler, Haddon Heights, N. J., was continued as president, John R. Downes, Bound Brook, N. J., as secretary and Weston Gavett as treasurer of the association.

Contract Let for Dam on Stave River

At a contract price of $882,987, which is exclusive of the cost of cement supply, Stuart Cameron & Company, Ltd., and Armstrong, Morrison & Company, Ltd., both of Vancouver, B. C., have received the contract to build the 183-ft. dam for the British Columbia Electric Railway Company's hydro-electric power project on the Stave River at Ruskin. Eleven other bids were submitted, the second lowest being that of Henry & McFee, Ltd., Vancouver, $1,018,090. The cement will be supplied by the company at a cost of $300,000. Total cost of the dam is estimated at $1,500,000. Other contracts for tunnels, hydraulic and electrical machinery and other power plant equipment will be let soon. All contracts are to be completed by Dec. 31, 1930.

City of Centralia, Wash., to Build Power Plant

At a recent special election held in Centralia, Wash., a proposition to issue bonds for construction of a municipal power plant was carried by a large majority. The project is estimated to cost $950,000, of which $650,000 will be covered by the issuance of utility revenue bonds. Plans provide for a diversion dam on the Nisqually River with a canal 32 ft. wide at the top and 16 ft. at the bottom to carry the water 9½ miles to Yelm, where a power plant of 11,000-hp. capacity will be erected.

Ownership of a hydro-electric plant has been under consideration by Centralia for some time. The city at present is receiving current from the Western Cross Arm & Manufacturing Company for its municipal distributing system under contract which has about ten years to run but contains a provision for its abrogation if the city should have a hydro-electric plant in operation by Oct. 31, 1930. The proposed plant is expected to be in operation by Oct. 1, 1930.

Engineering Societies

CALENDAR

ANNUAL MEETINGS

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; spring meeting, Dallas, Tex., April 24-26.

AMERICAN WELDING SOCIETY, New York; annual meeting, New York City, April 24-26.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston; annual convention, Memphis, Tenn., May 13-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; annual meeting, Atlantic City, N. J., June 24-28.

AMERICAN WATER WORKS ASSOCIATION, New York; annual meeting, Toronto, Canada, June 24-28.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; annual meeting, Mexico City, Aug. 26-28.

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THE FLORIDA ENGINEERING SOCIETY held its thirteenth annual meeting at Clearwater, Fla., March 14 to 16, at which numerous committee reports and a few individual papers were read. Speakers at the annual dinner included George T. Seabury, secretary of the American Society of Civil Engineers, and A. A. Potter, dean of engineering at Purdue University.

THE LOS ANGELES SECTION, American Society of Civil Engineers, held its regular monthly meeting on March 13, devoting much of the evening to talks by past-presidents of the section. Most of those who have presided since the section was formed in 1915 were present. An attractive bronze paperweight shaped like the society badge and appropriately marked was presented to each past-president with comment by the one who had preceded him in that office.

THE IOWA POWER AND INDUSTRIAL CONFERENCE under the auspices of the College of Engineering, University of Iowa, the College of Commerce and Extension Division co-operating, will be held in Iowa City on April 2, 3 and 4. This conference is an outgrowth of the Iowa Power Conference of previous years and its purpose is to provide a forum for the discussion of power resources and the industrial development of Iowa.

THE STRUCTURAL ENGINEERS ASSOCIATION OF SOUTHERN CALIFORNIA has just been organized to afford a means through which all practicing structural engineers in the southern part of the state may work together on matters of common interest. Meetings will be held monthly at the Los Angeles Engineers Club. Officers are: president, Paul E. Jeffers; vice-president, Mark Falk; secretary-treasurer, Ralph A. DeLine. The first regular meeting was held March 6.

Personal Notes

FOSTER TOWLE, for the last five years designing engineer in the Isabela irrigation service, for the government of Porto Rico, has returned to the United States, the project being completed. He is at present in Amesbury, Mass.

C. V. BAKER, formerly senior resident engineer, North Carolina State Highway Commission, located at Wilmington, is now construction engineer, Louisiana Highway Commission, with headquarters at Baton Rouge.

W. C. LEFEBVRE, former Arizona state engineer, has been named city manager of the city of Phoenix, Ariz., by the city commission to succeed City Manager C. E. Griggs, formerly city engineer of the city of Tulsa, Okla.

BERESFORD M. ALEXANDER, of Jamaica, B.W.I., a Cooper Union graduate of the class of '28, has been appointed to the surveying branch of the Public Works Department at Kingston, Jamaica. Mr. Alexander was previously with the Royal Engineers of the British Army.

ERNEST R. ROGERS has been appointed district engineer of the Kansas City office of the Portland Cement Association, succeeding R. M. Simrall, resigned. Since April, 1924, Mr. Rogers has been a field engineer in the Indianapolis district of the association and previous to that time spent nine years in the engineering corps of the Pennsylvania Railroad with headquarters at Fort Wayne, Ind.

FRANK S. SENIOR, EDWARD D. PALMER and HOWARD C. BOOZ announce that they have organized the firm of Senior & Palmer, Inc., to engage in the business of engineering and contracting, with offices at 50 Church St., New York City. All three have been connected with the Arthur McMullan Company, Mr. Senior as vice-president for fifteen years and Mr. Palmer as secretary since 1921.

E. M. FLEMING has been appointed manager of the highways and municipal bureau of the Portland Cement Association, with headquarters at the general office in Chicago, succeeding L. S. Trainor, who resigned Jan. 1. Mr. Fleming for the past year has been street engineer in the highways and municipal bureau at Chicago headquarters. He was associated with the Illinois division of highways in various executive capacities for about six years during construction of that state's model concrete highway system.

Construction Equipment and Materials

Shop Crane to Be Fabricated From Aluminum Alloy

A 10-ton traveling shop crane, the main girders of which are to be fabricated from aluminum alloy, has been ordered by the Aluminum Company of America from the Alliance Machine Company, Alliance, Ohio. The use of aluminum will materially reduce the wheel loads on the building and it is expected that it will also reduce operating costs. Upon completion, the crane will be installed in the new structural-shape mill at the Aluminum company's Massena works. At the same time it is planned to install a duplicate of this crane built of steel in the blooming mill at Massena in order that direct comparisons of operating expense can be made.

Concrete Pavement Yardage

There is given below a tabulation of concrete pavement yardage awarded during the month of February, 1929, and also the total number of square yards awarded for roads, streets and alleys to March 2, 1929:

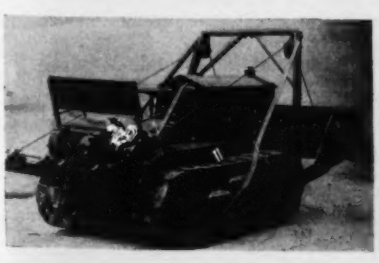
	Square Yards Awarded During February, 1929	Square Yards Awarded From Jan. 1, 1929 to March 2, 1929
Roads	1,689,358	7,778,032
Streets	1,507,550	2,816,232
Alleys	44,271	108,081
Totals	3,241,179	10,702,345,

New Developments

New Power-Operated Bulldozer Follows Ground Contour

A new power-operated bulldozer for attachment to the Cletrac Model 30-A has been announced by the Miami Trailer-Scraper Company, Troy, Ohio. The bulldozer is entirely independent of the tractor drawbar and does not interfere with the free use of the tractor as a pulling unit.

As may be seen in the illustration, the 7-ft. bulldozer blade is carried on H-beams and is raised and lowered by two steel cables so attached at the ends as to insure an even lift in places where one end only of the blade is under load. A distinctive feature of the bulldozer is the method of mounting the "A" frame (which carries the cables) by means of a universal connection direct to the track frame, thus insuring that the blade will follow the ground contour.



The power winch, manufactured for use with the bulldozer, is so designed that it is also available for use with other Miami products such as the one-man power scraper, power dump trailers and backfillers. The winch is driven from the power take-off of the tractor with a double roller chain through a multiple-disk clutch designed integral with an overrunning brake which permits the tractor operator, by means of only one lever, to control all movement of the load. The company is now engaged in producing similar equipment for other tractor makes and models.

New Instrument Indicates Presence of Combustible Gases

A portable instrument that detects immediately the presence of a wide range of combustible gases or vapors and indicates whether or not the atmosphere containing these gases is safe to breathe and safe for flames or fire has been developed by the Union Carbide Sales Company, New York City. First developed as a methane-indicating detector and in such form approved by the U. S. Bureau of Mines, the new gas indicator is identical in construction except for minor modifications. In operation it utilizes the effect of the combustion of flammable gas and air mixtures on the surface of a heated filament. The combustion increases the electrical resistance of the filament, and this causes the needle of a meter to move over a scale, from which the desired information relative to gas conditions is obtained. The apparatus consists of a detector head or combustion chamber, a meter case, and a portable storage battery.

Acid-Proof Cement

A new acid-proof cement to be sold under the trade name of "U. S. Standard" has just been placed on the market by the U. S. Stoneware Company, 50 Church St., New York City. The cement, which is the result of several years of intensive research, is claimed by the manufacturers to resist successfully all acids, alkalis, chemicals and gases, weak or strong, hot or cold, the sole exception being hydrofluoric acid. The silica content of the cement is 70.07 per cent, which is claimed to be at least 10 per cent more than in any other competitive cement. Unusually fine grinding is also one of the special characteristics of this new cement.

New Publications

Arc Welding—LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, has published a bulletin entitled "Suggested Designs for Arc-Welded Connections in Building Construction." The bulletin is a reprint of a paper presented at the annual meeting of the American Welding Society by J. F. Lincoln, vice-president of the company.

Power Shovels—BAY CITY SHOVELS, INC., formerly the Bay City Dredge Works, Bay City, Mich., has published two new catalogs, one covering its model R 26-ton ¾-yd. full revolving machine, the other being devoted to the company's tractor shovel, a ¾-yd. excavator built around the McCormick-Deering tractor power unit. Catalog R-2, devoted to the model R, includes complete specifications, together with illustrations of various machine details and diagrams of working ranges with the machine fitted both as a shovel and as a crane. Catalog T-5 includes diagrams and sketches showing working ranges and capacities of the tractor shovel. It is largely made up of working pictures of the machine handling a wide range of work with different bucket attachments.

Roadbuilding Equipment—SULLIVAN MACHINERY COMPANY, Chicago, has made available Form 2007, an eight-page bulletin illustrating various types of equipment, such as portable compressors, pavement busters, spaders and drill steels, that are applicable to road work.

Floodlighting — NATIONAL LAMP WORKS of the GENERAL ELECTRIC COMPANY has published a new bulletin on floodlighting. It is written by O. M. Haas and K. M. Reid, of the company's engineering department, and contains a thoughtful and complete study of the design of floodlighting installations of various types and for various purposes. The floodlighting equipment and its

various component parts are illustrated and described. About ten pages are devoted to the subject of equipment location and mounting and an additional fifteen pages to the detailed design procedure necessary for a typical installation. This is assisted by tables, formulas and diagrams. Numerous illustrations of floodlighting effects complete the bulletin.

Pavers — RANSOME CONCRETE MACHINERY COMPANY, Dunellen, N. J., has published a new catalog entitled "The Master Paver." The booklet contains complete descriptions of the power loader, water control, drum, drum rollers, discharge, boom, boom bucket, supporting frame, operating levers, engine, gears, shafts, clutches, main frame, crawler, crawler drive, derrick, distributing chute and calcium chloride attachment. Photographs also show these various details. Several illustrations of the paver in operation on jobs in different sections of the country are featured. Diagrams and specifications give a complete picture of the new Ransome 27-E. A brief section is also devoted to central mixing plants.

Plow Scrapers — GARST MANUFACTURING COMPANY, Chicago, Ill., has published a new bulletin describing its power plow scraper. Several pages are devoted to the history and development of the power plow scraper, followed by features of the Garst V-type scraper, showing its principles of operation and its versatility of use, the latter occasioned by a simple method of varying its capacity by an adjustable lid. Various parts of the plow scraper are illustrated and described. Illustrations are given of the scraper in operation. Several pages in the back of the catalog are devoted to diagrams showing the principle of operation on such material-handling work as material storage, road grading, under-water excavation, sand dredging, levee construction, bridge approach construction, river straightening, backfilling work and gravel and sand operations.

Steel Beam Sections — CARNEGIE STEEL COMPANY, Pittsburgh, Pa., has published a second edition of its pamphlet setting forth the additions to its new series of Carnegie beam sections. Complete ordering and designing data such as are included in the company's "Pocket Companion" are given in this supplementary pamphlet.

Valve Control Practice — CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has published a second edition of its catalog "Modern Valve Control Practice." The bulletin describes the company's automatic valve control system utilizing motor-driven valves. This new edition contains additional information and data not included in the original book. New photographs show the use and installation of motor-driven valves. These views are grouped by applications showing the service rendered in power plants, waterworks, gas plants, etc.

Stress Instruments — SOUTHWARK FOUNDARY & MACHINE COMPANY, Philadelphia, Pa., has published a bulletin describing three of the stress-measuring instruments which it manufactures. Section 1 of the bulletin is devoted to the McCollum-Peters electric telemeter. Section 2 is devoted to the Wittemore strain gage. Section 3 is devoted to the Huggenberger tensometer.

Elevator Control — GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has devoted a new bulletin, No. 985, to a discussion of its elevator control equipment. The bulletin discusses automatic control of speed regulation both at running speeds and at approaching or landing speeds, automatic control of acceleration and retardation and the automatic leveling control used with the elevator apparatus which also includes automatic opening of the doors.

Air Compressors — PENNSYLVANIA PUMP & COMPRESSOR COMPANY, Easton, Pa., has published a new bulletin, No. 144, describing its duplex air compressor in the single- and double-stage types of compression. The bulletin breaks the machine down into its component parts, describing and illustrating each. Although several different methods of drive are outlined, the use of direct-connected synchronous motors is stressed and given precedence.

Construction, Automotive and Materials Industries Flourishing

The construction and automotive industries with their present high activity are doing much to hold general business at a strong level of production. The accompanying tabulation presents the picture of comparative activity in certain lines in the first two months of 1928 and 1929.

Despite a serious decline in the value of contracts let for residential building this year, construction as a whole is operating at 18 per cent above last year; and it will be recalled that 1928 set a new record. The striking figure is that for engineering construction, which is 85 per cent above the total for the first two months of 1928. The feature is the size of the increase and not the fact that there was an increase. The first quarter of 1926 was 25 per cent above the first quarter of 1925; 1927 was 5 per cent above 1926; 1928 was 25 per cent above 1927.

In the automotive industry 52 per cent more passenger cars were produced in the first two months of 1929 than in that period of 1928, and 88 per cent more trucks.

With these two materials-consuming industries so busily engaged, it is reasonable to look for increased activity among the materials-producing industries. The tabulation shows steel ingot production and fabricated structural steel sales leading last year's tonnage by 10 and 14 per cent, respectively.

The 23 per cent increase in production of softwood is particularly significant in view of the strict regulation of production to demand in this industry.

Cement producers are watching stocks, which are a little higher than need be, with the result that production dropped slightly in February. There has been no falling off in demand.

The common brick industry does not furnish production figures. The table lists the only brick figures available, which are orders on books. The decline of 38 per cent in January, from January, 1928, may not reflect lower demand but merely that orders have been filled from stock.

JANUARY-FEBRUARY PRODUCTION

Materials	1929	1928	Per Cent Change
Steel ingots (tons)	8,814,150	8,036,636	+10
Fabricated shapes (sales) (tons)	542,850	477,400	+14
Fabricated plates (new orders)	93,730	85,607	+ 9
Malleable castings	147,852	126,431	+17
Softwood lumber (M ft)	2,162,327	1,761,568	+23
Portland cement (bbl.)	18,403,000	18,565,000	—1
Brick, common, orders on books Feb. 1 (1000s)	136,014	219,233	—38
Floor and wall tile (sq.ft.) January	4,298,661	4,019,156	+ 7
Terra cotta (tons)	21,326,000	21,134,000	—1
Porcelain plumbing fixtures, unfilled orders Feb. 28 (pieces)	37,426	23,464	+59
Residential	$280,000,000	$470,000,000	—40
Engineering	760,000,000	410,000,000	+85
Total	$1,041,000,000	$880,000,000	+18
Automotive: Passenger cars	756,700	496,797	+52
Trucks	110,099	58,727	+88

Cost and Contracts

E. N.-R. Index Numbers

Cost		Volume	
Mar. 1, 1929	**207.78**	**February, 1929**	**278**
Feb. 1, 1929	210.40	January, 1929	325
Mar. 1, 1928	204.65	February, 1928	225
Average, 1928	206.78	Average, 1928	287
Average, 1927	206.24	Average, 1927	263
1913	100.00	1913	100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of March 28, with some comparisons, total as follows:

(In Thousands of Dollars)

	Mar. 28, 1929	Mar. 21, 1929	Mar. 29, 1928
Building:			
Industrial	$4,788	$9,295	$5,773
Commercial	46,672	36,215	61,967
Streets and roads	4,089	4,352	15,143
Other eng. constr.	9,710	6,061	18,151
Total	$65,259	$55,923	$101,034
Total, all classes, Jan. 1 to Mar. 28:			
1929			$1,121,942
1928			790,793